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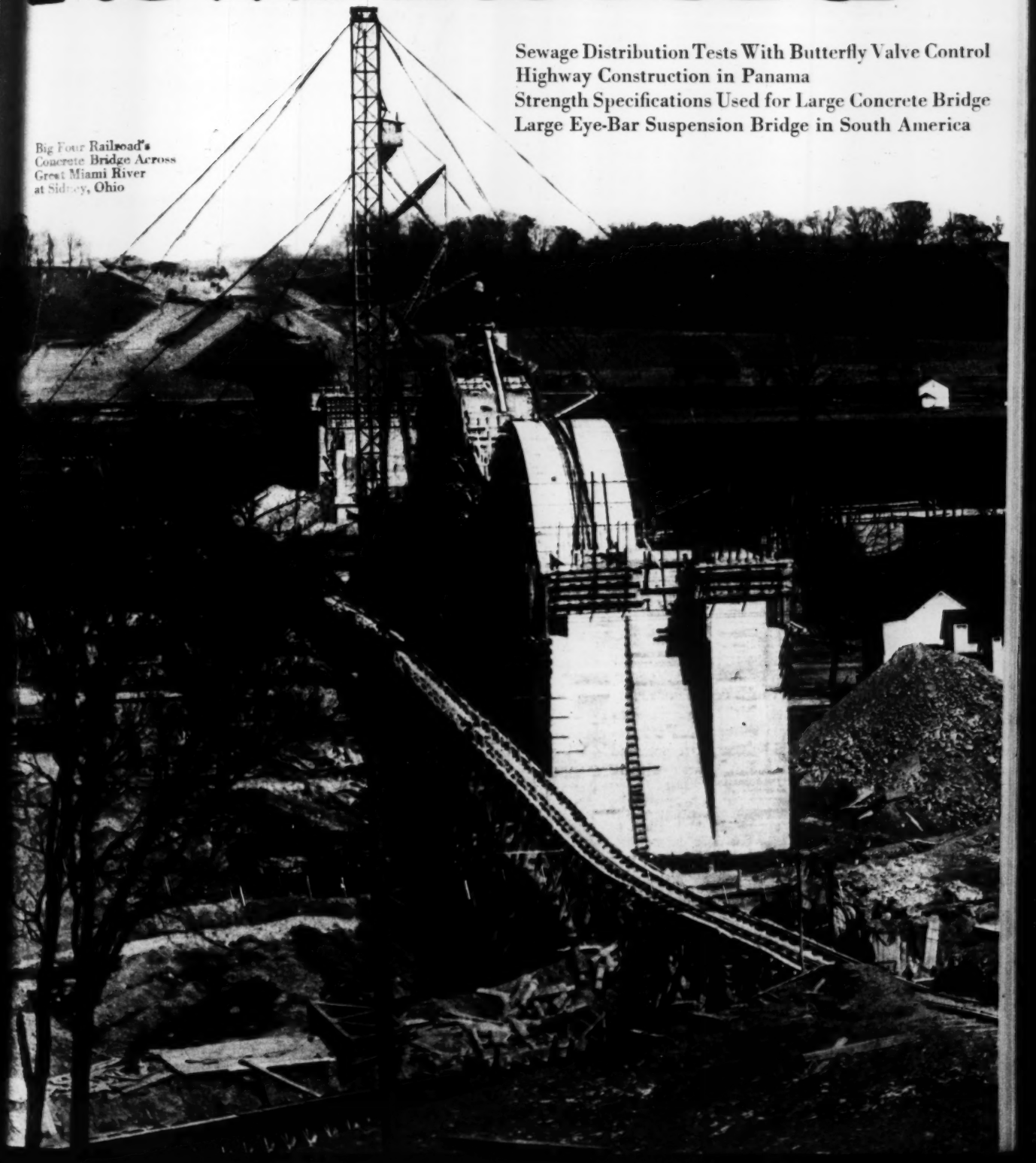
Strength Specifications Used for Large Concrete Bridge
Large Eye-Bar Suspension Bridge in South America



Big Four Railroad's Concrete Bridge Across Great Miami River at Sidney, Ohio

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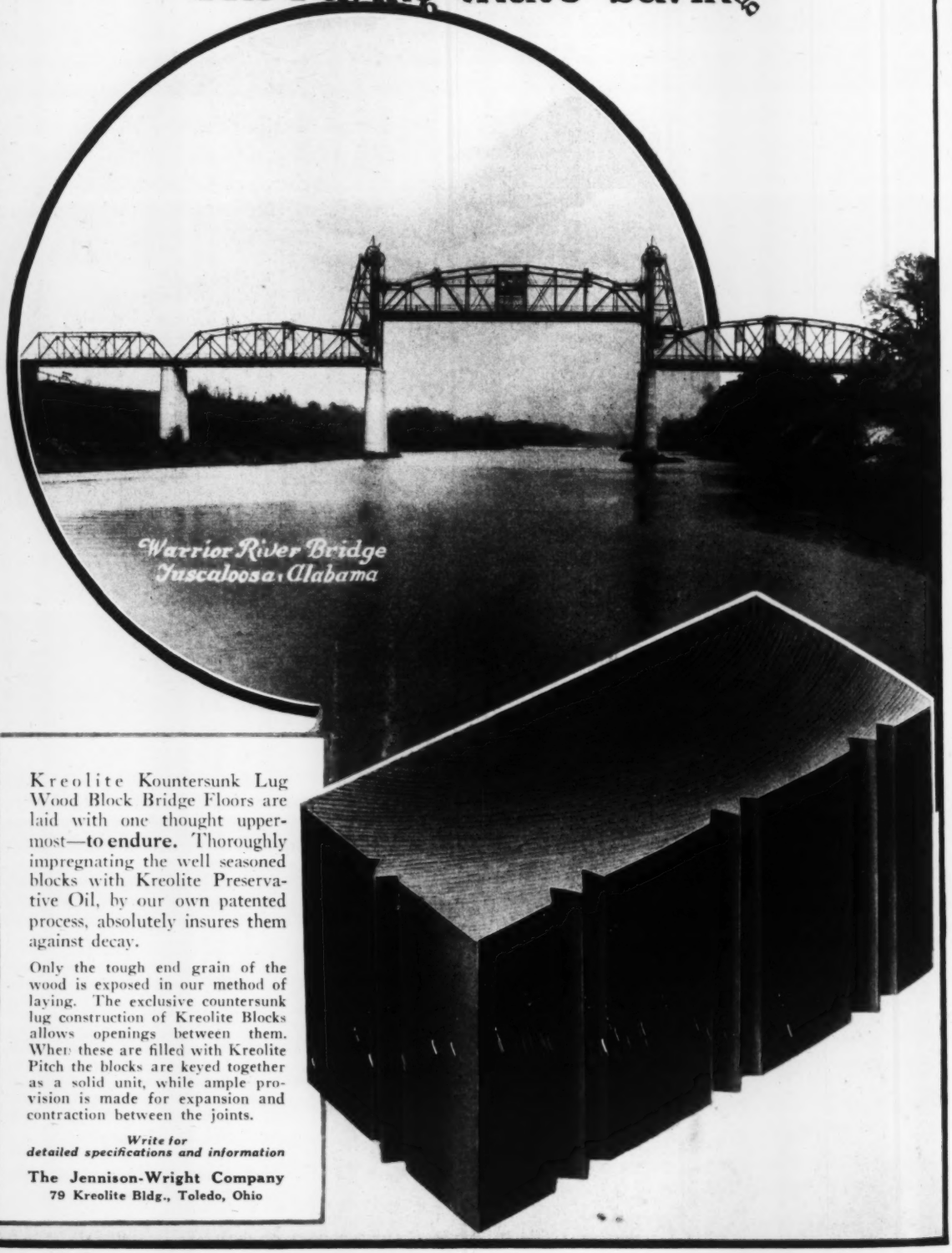

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

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FRANK C. WIGHT, *Managing Editor*

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Why Not a Cement Committee?

THERE is no doubt that there is a growing feeling among engineers that we do not know enough about the real nature of portland cement. It is an obscure material, of complicated composition and with curious reactions, affected acutely by processes of manufacture. It is in recognition of this feeling that the cement manufacturers, as announced by one of their number at the last meeting of the American Society for Testing Materials, have initiated a study into the nature of their product. More should be done. It seems an excellent time for the American Society of Civil Engineers to revive its committee on cement, which long ago initiated the movement for cement specifications. It is true that the subject of cement is taken care of by the Testing Materials committee, but whether that committee intends it or not it seems to be bound too close to the existing specification which it sponsored to get a true perspective on present cement needs. A new committee of the Civil Engineers, starting on the subject afresh, should achieve some useful results to supplement what the manufacturers do.

Water-Waste Prevention in Chicago Started

JUST how much credit the Western Society of Engineers can take to itself for the latest move in Chicago toward water-waste prevention is problematical. The campaign of the society's public affairs committee for waste curtailment was kindly receiver when the present administration went into office and much direct praise has come from the mayor. Anyway, a start has been made. The finance committee of the City Council has recommended the transfer of $187,000 from funds set aside for a new pumping station for the installation of meters in large apartment and industrial buildings. Opposition to the metering is likely when the City Council is asked to ratify the action of its finance committee but in general the committee recommendations usually prevail. Heretofore, it has been the stumbling block. Getting its approval is therefore tantamount to accomplishment. Other controversial engineering subjects in Chicago are being threshed out in the society's committees. May they have as successful issue.

Responsible Contractors

ASSURANCE of responsibility is a prerequisite to any considerable modification of specifications which place drastic restrictions on contractors. In every recent conference which contractors have held with engineers to consider contract forms this requisite has been made plain by the engineers. As a result the committee on ethics of the Associated General Contractors has set about the task of defining responsibility. It suggests as the factors involved, financial strength, experience, equipment, performance record and personal reference. The committee probably recognizes as fully as anyone that when every factor named has been determined, the query whether a contractor is responsible has not been answered. Much less has the irresponsibility of the contractor been established. The mental attributes which establish responsibility are not told by money or plant or testimonials but all these taken with a record of past performance are as certain and reliable an indication as the exigencies of canvassing a score of bidders permit the engineer to secure.

Exchange of Engineers

EXCHANGE of college professors between America and Europe was instituted before the war and proved helpful in many ways. A similar though less extensive intercourse between engineers on the two sides of the Atlantic was suggested some months ago by H. C. H. Shenton, president of the Institution of Sanitary Engineers. A friendly letter on this subject, by Mr. Shenton, elsewhere in this issue, tells of the kindly reception given to George W. Fuller when he appeared at a meeting of the Institution to give in London early in September an address on American sanitary engineering practice. It is to be hoped that there may be early and repeated opportunity for American engineers and engineering societies to extend like courtesies to British engineers. We do not mean to imply that such exchanges have been wholly lacking in the past but for the most part they have been incidental. More definite planning for this sort of thing is desirable. How it can best be effected is a subject for consideration by the leaders in some of our engineering societies.

Let Road Legislation Rest

STATE highway management appears to have been selected again for legislative attack. Candidates for governor in the coming elections are talking freely of how they will handle highways. The plans range from "canning" some politically intractable road official to changing the organization and policies of a whole highway department. With the people also in a hectoring mood because of high taxes, highway officials obviously need have no fear of a dull winter. Quite as obviously the situation promises no help to sound highway development. Indeed, except in the matter of improved or increased financing, a complete rest from immediate further highway legislation would seem wise. In 1922-3 the legislatures of all but four states were in session. The count of their highway activities is impressive. In nine states the lawmakers changed highway administrations; in nineteen they changed methods of financing construction or maintenance or both; in fourteen they changed motor fees and the distribution of this income, and in thirty-two they increased old or created new gasoline taxes. Add to these changes

the acts having to do with appropriations and with traffic regulation and our "road laws" of last winter number about 170 and each one requires some regearing of the highway business machine. It has taken engineers about all the year since the legislatures adjourned to adjust the business to the changes and to get going on the altered basis. Again it should be said, it would appear to be time to take a rest from highway legislation and to develop the business of improving highways.

Public Servants

CONCERN over the large number of persons now on our federal, state and city payrolls is expressed in a circular sent out by the National Industrial Conference Board of New York City. The Board says it has found that exclusive of pensioners there are 2,700,000 "public servants" on the payrolls of the country drawing about $3,500,000,000 annually. Such figures are interesting and to a degree impressive, but they mean little without data to show what services these employees are rendering that are not useful to the people of the United States and what part of the cost of these services would be paid to private agencies of one kind or another if our federal, state and city governments did not have these men and women on their payrolls. The significant thing is not the number of public servants and their total drafts on our various public treasuries, but how much of the work they do and the wages they draw are useful; and at what reduction in numbers and in cost the useful work could be done (1) publicly and (2) privately. Is not the work done by the National Industrial Conference Board itself in collecting these and other statistics an economic charge on the people of the whole country? Are not the Board's employees, as well as those of privately-owned utilities, and of contractors engaged in city and state construction work, public servants—good servants if their work is useful and rendered measure for measure, bad otherwise?

Low Maintenance an Asset

ALL OTHER things being equal in the question of steel versus concrete bridges, does the concrete structure offer to a city any advantages that would not apply to a corporation, such as a railroad, because of the fact that the city is subject to political pressure in the allotment of maintenance funds, while the corporation is free from such influence? The theory that there is such an advantage has been advanced by a city which found it difficult to get the council to appropriate funds for painting steel bridges. To be more explicit, the city in question has jurisdiction over eight comparatively small steel bridges. The painting of these structures was repeatedly urged by the city engineer, but was put off by the city fathers from year to year until, after ten or twelve years, it became so urgent that even the politicians could ignore it no longer. At this delayed date, however, the necessary work included a thorough scraping of the structures and three coats of paint. The city has spent $27,000 this year on these eight steel bridges and faces the expenditure of some $16,000 more to complete the work properly—a total amount considerably in excess of what would have been required by maintenance on a regular and systematic basis. Concrete bridges in the same city, on the other hand, have required and have received practically no maintenance and have therefore made a very favorable impression. In selecting the most suitable type of structure for a given set of conditions the engineer must give due weight to just such psychological considerations as that advanced in this case. Even in a well regulated city political parties may change, and what seems a stable policy today may be overthrown tomorrow. It may very well be that "fool proof" structures can best be entrusted to the uncertainties of political management.

Motorists Finance Roads

AMERICANS are spending about a billion dollars a year in highway improvement. To do this they are putting over the biggest accomplishment in special taxation ever recorded for public works—the motor license and the gasoline tax. The general property tax dollar is not building roads. Less than six cents of this dollar goes to highways. The general property tax is also not being increased by our growing road improvement program. Instead it was reduced last year in a number of states—generally by boosting motor car license fees or by imposing a gasoline tax. The motor vehicle is paying for good roads and not general property. This fact needs to be made plain by state road officials and by the associated motor vehicle interests. In this matter they have identical interests even though they may disagree on every other particular of the relation of the highway and the motor vehicle. It is on the plea of reducing the general property tax that the "practical" politician is urging local management of road funds and decentralized technical control of road work. To return to either of these practices in entirety would reverse all the policies which are now developing highways as state and interstate systems—which are creating the through routes essential to the motor truck and bus carrier and the automobile tourist. As their customers and members are financing the roads, this development is the particular concern of the associations of manufacturers and users of motor vehicles. They should actively uphold the hands of the federal and state departments in advancing centralized control and engineering direction of highway improvement.

From Laboratory to Field

FOR four or five years a few experts have been trying to impress on the concrete users of this country that there is a more economical and a more consistent method of proportioning concrete than the generation-old system of integral quantities. The idea, though, has been slow of acceptance and the old 1:2:4 concrete continues to be placed in by far the larger number of actual jobs. It is a hopeful sign of progress when a large railroad, such as the Big Four, undertakes the use of one of the more scientific methods of proportioning on so large a job as the Sidney Bridge described in this issue. Mr. Huntley's article was written before the full returns from the tests are available. It also will require for complete understanding a knowledge of Professor Abrams' bulletins describing his method of proportioning concrete. Nevertheless, it is sufficiently complete at the present time to make clear that the engineers of the railroad are quite satisfied with the system which they adopted, and that they are assured that the concrete produced is not only more uniform in strength, but was produced at less cost than would

have been possible under the older and somewhat simpler methods of proportioning.

It should be recalled that the other big experiment in scientific proportioning was the concrete on the Queenstown-Chippawa Canal, where the methods devised by R. B. Young of the Ontario Hydroelectric Power Commission were used. These methods and their application to the Chippawa work have been extensively described in *Engineering News-Record*. The work on that project is practically complete, and it may be interesting to note that there, too, the engineers are convinced of the efficiency of the design method of proportioning. There is quite a difference in the Abrams and the Young details, as the students of the two methods well know, but the methods are aimed at the same results, and apparently those results are equally well achieved by either method. What it is important for other engineers and contractors to realize is that these methods have now gotten beyond the laboratory stage and are now being used on extensive operations where money is important, where time is important, and where the strength of concrete is most important of all.

Departmental Reorganization a Live Issue

IN DECEMBER a new Congress meets in Washington with a different personnel from the one that adjourned last spring and under considerably different conditions. The election last November brought forward a number of new men who will come together for the first time to try to do business with a new President, at a time when political pots are boiling as they have not boiled in many years. In this confusion of politics it may seem that the obvious necessities of government will be subordinated to the expediencies of bloc or party, but, on the other hand, the fact that so many new elements have entered into the legislative mechanism may lead to a striking out into paths which the more hidebound of the veterans in Congress have hitherto been reluctant to tread. For that reason, it behooves the engineers of the country to lay their plans now for the presentation to Congress of the necessity for departmental reorganization at Washington.

There is no need here to recite the long history of the campaign to render more efficient the work of the government by the proper alignment of the various functions of government. It will be remembered, however, that at the initiation of President Harding a committee, known as the Brown Committee, presented to the last Congress a scheme for departmental reorganization which involved the re-assignment of various bureaus in a more orderly arrangement, but which was most important because it collected all government engineering under one head, the Department of the Interior, with a subordinate to the Secretary of the Interior who should have engineering qualifications and who would be in complete charge of the engineering activities of the department, which means the engineering activities of the federal government.

The necessity for some such arrangement is quite obvious; it has, in fact, been quite obvious for many years, but the recent performance of the Secretary of the Interior in summarily removing Arthur P. Davis from the direction of the Reclamation Service brought forcibly to realization the dangerous possibilities of the present political control of the scientific branches of the government. So long as a man like Herbert Hoover is a cabinet officer or, to get outside the engineering profession, so long as a man such as James R. Garfield was a cabinet officer, there was small chance that the strictly engineering activities of a government department would be made subordinate to the needs of some chance politician out of a job. But when a political accident happens to come to power and when the exigencies of political control become so forceful as they apparently are in the Far West today, the danger of the present organization of the government department becomes apparent.

Some system of organization must be provided whereby the head of an engineering department will be by law required to be an engineer, as a general in the army must be a soldier by profession, and as the head of the Bureau of Mines must be a qualified engineer or geologist. No political superior should be empowered to juggle the law so as to take from that engineering head the responsibilities that should be his. It should be possible, of course, to remove individuals; it should not be possible to substitute so-called business men or administrators for trained engineers.

The Brown departmental reorganization may not be the best method whereby this end can be achieved, but it has the merit of the adoption by an expert committee after long study and at least stands a better chance of passing in Congress than some unauthorized scheme gotten up on the spur of the moment. Engineering societies would do well to study the main features of the Brown plan and to advise, through their local chapters, their respective congressmen of the necessities of the situation. The coming Congress will no doubt take up the Reclamation Service scandal as a specific matter, and there is a strong probability that the proper engineering control of this engineering body will be forced on a reluctant Secretary of the Interior. The attention of each congressman should be called to this possibility, but the general situation in Washington should not be overlooked. If one Secretary of the Interior can remove an engineer who has for forty years been in the service and take out of engineering control an efficient engineering bureau of twenty-one years' standing, there is nothing to prevent some other secretary from putting a country lawyer at the head of the Geological Survey or an Oklahoma gunman at the head of the Bureau of Standards. This possibility must be removed by guaranteeing at the head of the government engineering bureaus some single individual whose qualifications by law are such that whatever his personal disabilities may be, he would appreciate the necessity for the engineering direction of engineering work.

The engineers of the country might well ask Congress for some such legislation, not with any selfish purpose but with full knowledge that the government service will suffer under a political control. Group action of the engineers through their major societies and through the Federated American Engineering Societies will be useful but the most useful service can be performed by each local society or chapter with its single congressman. There is not a member of Congress who does not number among his constituents some organized groups of engineers whose opinions he is bound to consider. By making this an aggregation of local issues it can be made a paramount national issue. Persuade your Congressman and Congress itself will be persuaded.

Strength Specifications Used for Large Concrete Bridge

Abrams Method of Proportioning Concrete Used on the C.C.C. & St. L. Ry. Bridge Over the Great Miami River at Sidney, Ohio—Both Premixed and Separate Aggregates Used

By J. B. Huntley
Engineer of Bridges and Structures, C. C. C. & St. L. Ry., Cincinnati, Ohio

THE adoption of a concrete arch, ballasted deck bridge for the new double-track crossing of the Great Miami River at Sidney, Ohio, by the C. C. C. & St. L. Ry. is indicative of the present tendency in railroad bridge design, particularly when, as in this case, the bridge is within the limits of a city. This new bridge is on a relocated portion of the railroad where existing structures do not limit the design and where

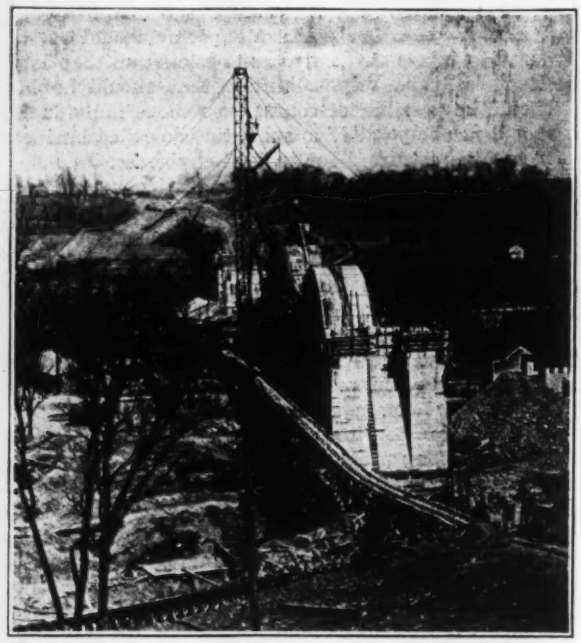


FIG. 1—VIEW SHOWING LOCATION OF CONSTRUCTION PLANT

rock foundations make it possible, without excessive cost, to use fairly long span arches. Some features of the design are notable and are given below but the principal interest in this bridge is centered in the construction methods, particularly the method of proportioning concrete.

Design—The structure, as finally designed, consists of three 140-ft. spans over the river channel and the highway, and one 100-ft. approach span on each end to take the embankment slopes, making the overall length of the structure 780 ft. The height from base of rail to bed of stream is 95 ft. The track will be carried on a ballasted deck which is supported on spandrel arches having a span of 9 ft. 9 in., the top of the parapets being 3 ft. above the rail. The piers are 17 ft. thick at the springing line, with a moderate batter, but piers 1 and 4 are widened near the base to provide for the unbalanced load between the 140-ft. and 100-ft. spans. The footing courses are carried about 2 ft. into the rock, which is a peculiar form of limestone, unstratified, very hard and at least 35 ft. thick, as shown by the deepest test hole. The piers are extended for buttresses, and above the haunches of the arch are hollow. Expansion joints in the floor and parapets are provided at the ends of each span.

The structure was designed for E70 loading, using equivalent uniform loads. This uniform load, considering half of the span loaded, was 10,400 and 10,900 lb. per foot of track for the 140 and 100-ft. spans respectively, and considering the entire span loaded, 8,500 and 8,600 lb. per ft. of track. Specifications impact was used, the impact percentage of the live-load being about 55 per cent for the 140-ft. spans and 68 per cent for the 100-ft. spans.

The 140-ft. arches are three-centered, having a rise of 50 ft.; the thickness is 5 ft. 6 in. at crown and 13 ft. 9 in. at haunches. The 100-ft. spans are semi-circular, and have thicknesses of 4 ft. 6 in. at crown and 10 ft. 9 in. at haunches. There is no tension developed at any section under live and dead-load, but temperature reinforcement was provided at the intrados and extrados, consisting of 1¼-in. square bars 12 in. on centers in the 140-ft. spans and 1-in. square bars in the 100-ft. spans.

Stresses due to a rise of 50 deg. and fall of 30 deg. in temperature, combined with live and dead-load and the effect of rib shortening, were found to be quite large. The intensity of stress at some of the critical sections of the 140-ft. spans is shown in the subjoined table.

DEAD-LOAD AND LIVE-LOAD STRESSES — 140-FT. SPAN

Section	Live-Load on Entire Span				Live-Load on Half Span			
	Total	+ D.L.	L.L. +I	Per Cent of LL+I of Total	Total	D.L.	L.L. +I	Per Cent of LL+I of Total
Crown	375	290	85	23	340	290	50	15
¼ point	340	250	80	24	455	290	165	36
Haunch	200	170	30	15	270	170	100	37

TEMPERATURE STRESSES COMBINED WITH DEAD-LOAD, AND LIVE-LOAD ON HALF SPAN — 140-FT. SPAN

Section	For Rise of 50° in Temp.		For Fall of 30° in Temp.	
	Concrete	Steel	Concrete	Steel
Crown	+675	0	+760	— 5,500
15 ft. from skew back	+700	—5200	.....	.....
At skew back	.....	.....	+200	—10,500

The maximum pier reaction is 25,000,000 lb., giving an average pressure on the foundation of 10 tons per square foot. The maximum toe pressure at piers 2 and 4 under unbalanced loading will be 19 tons per square foot.

Waterproofing and Drainage—Experience with several structures of this type built about 15 years ago has shown that to avoid deterioration thorough waterproofing and ample drainage are necessary, and considerable study has been given to this detail. The deck will be sharply pitched to drains between the spandrel arches and waterproofed with a membrane, which will be protected with concrete. The fill between the ballast and deck will be of coarse material to permit free passage of water to the drain heads. The expansion joints over the piers and abutments will be flashed and counterflashed with copper, and the tops of the drains fitted with cast-

FIG. 2—CONSTRUCTION WORK AT BRIDGE SHOWING ARRANGEMENT OF PLANT AND ARCH CENTERING

iron flanges to flash and counterflash the membrane at this point. The deck drains lead through the pier walls, discharging into a channel on top of the main arches which will carry the water through the piers to the outlet. The lower portion of the chamber in the pier will be waterproofed to prevent seepage in case the outlet drain is clogged.

The structure will contain about 27,900 cu.yd. of concrete and 900,000 lb. of reinforcement.

Construction Plant—The arrangement of the contractor's plant for handling the material is interesting, and is shown in some detail in the accompanying sketch. The concrete materials are received on a track from the B. & O. R.R. about 1,000 ft. west of the bridge and on high ground, are unloaded by a locomotive crane and stored in piles over a timber tunnel through which tram cars run. The concrete aggregate is delivered through hoppers to the cars in measured quantities, and the bags of cement are placed on top. The cars run down an incline to the bridge, where the cement is added, and each car, containing one batch, is dumped into a hopper from which the mixer is charged. At first the cement was emptied on top of the aggregate in the car before leaving the tunnel, but it was found that there was some loss during the trip down the incline, especially in windy weather. The cars are operated in two trains, of 4 cars each, on a cable, and from the storage piles to the charging of the mixer practically all of the work is done by gravity. All laborers except those at the forms are under shelter, and continuous mixing and placing of the concrete is limited only by the formwork.

The mixed concrete discharges directly into the hoist of a 150-ft. steel tower and is distributed by chutes to most of the forms. In the abutments it was necessary to rehandle it by bucket and derrick, and for placing the concrete in the end spans and superstructure the chutes discharge into a car operating along an elevated trestle, which empties into distributing chutes. The inclination of the tower chutes was kept within the limits of 1 to 3 and 1 to 2. Each batch of concrete was mixed at least 50 sec. and for longer periods when it had to be rehandled by cars or buckets.

The excavation for the foundation was made by a 7-ton locomotive derrick on the west side and a 20-ton traveling stiff-leg derrick on the east side. These derricks were also used for rehandling the concrete from the chute to the forms which could not be reached by the tower, setting arch centers, etc.

Steel Centering, Camber and Deflections—Steel centering was used for all spans. Each set of centers consists of four ribs, which are three-hinged arches with bottom ties. They are made wide enough to pour one half of each arch, 16½ ft., and are rolled sideways, with the lagging intact, for the second half of the ring. Each half of each ring is poured in voussoirs of such size and in such order as to cause no undue reversal of stress in the arch centers. The centering is supported on double timber bents resting on top of the footing courses.

The trusses were cambered about one inch, and to allow for the take-up in the bents and blocking the shoes were set about 1 in. high. After the rings were poured elevations were taken on the 140-ft. spans and it was found that at the crown there was a settlement of about 2 in. and at the shoes about 1 in., verifying the original assumptions. After the centers were lowered (on the spans poured to date) elevations were taken on the arch ring to determine what settlement had occurred under dead-load, but none was apparent. The computed deflection at the crown of the 140-ft. span was found to be only 0.001 ft., and this was probably neutralized by the lengthening of the arch ring under rise in temperature. In fact there is some evidence that the rings had actually lifted themselves from the centers, as the wedges under the shoes were easily

backed out, although the computed load on the centering was about 1,700 tons. This condition would probably be reversed for arches poured in fall and winter.

Permanent points are being placed at intervals on one 100-ft. and one 140-ft. span, and it is the intention to take frequent elevations to determine the deflection as the work progresses and as the superstructure is added, and for some time after the completion of the bridge, under various ranges of temperature.

The centers were not lowered until 25 days after pouring of the arch ring, and 15 days after the last pouring on the adjacent spans. Due to the deflection of the centers under load, it was necessary to use some care in adjusting the centers for the second half of the ring in order to avoid a lip at the joint. After the centers were moved over, the inner truss was so near the completed ring that the crown was restrained and it was possible to jack up its bearings and introduce some initial deflection. This left the outer truss about one inch high at the crown, to deflect under load. To conceal a possible lip, a 4x6-in. channel was formed in the intrados where the two halves jointed.

After the concrete is poured an effort is made to keep it damp for at least two weeks. The tops of the arch rings are sprinkled several times daily, and as the deck is completed, the drain holes are plugged and it is flooded.

Proportioning the Concrete—Practically all concrete work of the company in past years had been poured under the ordinary specification, using the standard 1:3:6 or 1:2:4 mix, with probably average supervision but without especial care being given to the grading of the aggregate or the consistency of the mix, and some of this concrete has not been entirely satisfactory. It was felt that the importance of this particular structure required some unusual effort to assure the proper mixing and placing of the concrete, and, owing to the large volume, it offered an excellent opportunity to experiment with the method proposed by Prof. Duff A. Abrams, of the Structural Materials Research Laboratories, Lewis Institute, for the design of concrete mixtures. This method had been developed and confirmed in laboratory experiments but had not been used in the field to any great extent and there was some doubt as to the possibility of approaching the laboratory results, but it seemed that at least the mere moral effect of making the tests promised better concrete, and it would determine the practicability of adopting this method on future work, where there was sufficient yardage to justify it, and that possibly some evidence as to correctness or inconsistencies of present specifications and methods could be obtained.

It was decided to use mixes to produce concrete of the following strengths:

	Lb. per sq.in.
Footings	2000
Piers and abutments	2500
Arch rings	3000
Spandrel arches	2500

In the footings, piers and abutments, a premixed aggregate (concrete gravel) was used, of size 0 to 1½ in. The fineness modulus varied from 5.3 to 6.7, with an average of about 5.9. This wide range was probably due to separation of the sand and pebbles in unloading, and as the stockpile was large and the hoppers drew from the center of it the fineness modulus was uncertain, differing from day to day, and it was almost impossible to adjust the mix for the frequent variation in the aggregate. After some experimenting, it was found that, to avoid clogging the chutes, an average consistency as represented by a slump of 6 to 7 in. was required. The batches were 23.3 cu.ft. and the yield, or the ratio of the volume of finished concrete to the volume of loose damp aggregate, was assumed as 90 per cent to find the nominal mix, the true mix necessary to produce the required strengths being known after the consistency of the mix and characteristics of the aggregate had been determined. Including waste there were poured about 10,440 cu.yd. of gravel concrete, requiring about 11,700 cu.yd. of aggregate, which gives a yield of 89.0 per cent.

For the arch rings and spandrel walls separate aggregates are being used, the sand ranging from 0 to ¼ in. and crushed boulders and pebbles from ¾ in. to 1½ in. The fineness modulus of the fine and coarse aggregates remains quite uniform, averaging 3.2 and 7.8 respectively. For the arch rings the batches consist of 11 cu.ft. of sand and 17 cu.ft. of stone, and the mixture has a fineness modulus of 5.95. For the superstructure there is used 12 cu.ft. of sand and 16 cu.ft. of stone in each batch, the mixture having a fineness modulus of 5.8. The sand and stone when mixed should produce about 23.8 cu.ft. of gravel or 85 per cent by volume. The 23.8 cu.ft. of gravel should produce about 21.4 cu.ft. of concrete (90 per cent) or, the ultimate yield would be $28 \times 0.85 \times 0.90 = 21.4$ or about 76.5 per cent. To pour 4,800 cu.yd. of concrete required about 6,400 cu.yd. of separate aggregates, which gives a yield of 75 per cent. Tests were made on several batches and it was found that 28 cu.ft. of sand and stone would produce about 22.5 cu.ft. of concrete (80 per cent) in the bucket at the mixer, but there would probably be further shrinkage by the time it is placed in the forms.

The accurate determination of the yield is important, as by this factor alone can the nominal or working mix be found after the true mix, for the required strength, is known. It has been determined in the laboratories, but with comparatively small volumes and under somewhat different conditions than those which exist in actual construction. The amount of moisture initially contained in the aggregate materially affects the yield and this must be allowed for.

It was found that the concrete made of separate aggregates could be easily handled in the chutes and forms with a slump of 3 to 4 in. In fact many batches were poured in which the slump was 1½ to 2 in., the average being about 3¼ in. This produces a concrete much drier than it was thought could be handled through the chutes, and much drier than the gravel concrete previously poured with the same equipment. This seemed difficult to explain as the gravel, sand and pebbles were from the same pit, but it is undoubtedly due to the fact that the fineness modulus of the sand and pebbles remained nearly constant and that the mixture was such as to produce a very "workable" concrete, while the gravel varied greatly and was often of such a nature that it required an excess amount of water to make it workable. This same fact was observed in another structure containing about 6,500 cu.yd of concrete, built under a different inspector. Here the concrete was largely placed by buckets, but to get a good face on finished work required that the gravel

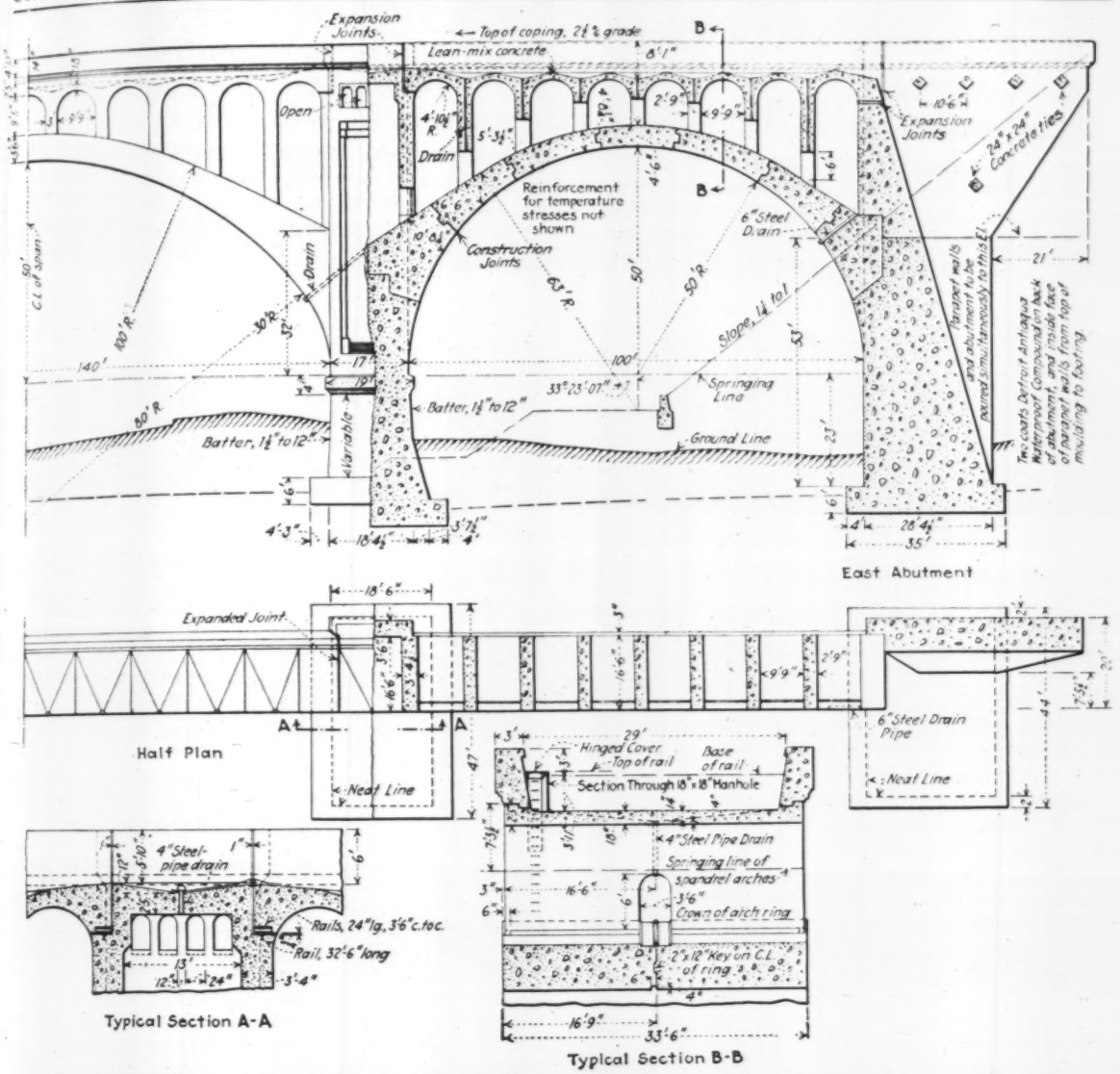


FIG. 3—DETAILS OF THE BIG FOUR RAILWAY BRIDGE ACROSS THE GREAT MIAMI RIVER AT SIDNEY, OHIO

mix have a slump of about 7 in., while the concrete made of separate aggregates worked nicely with a 3-in. slump. In one structure where a premixed aggregate was used throughout, the gravel being handled in small quantities and in such a manner that little or no segregation occurred, the fineness modulus remained nearly constant, it was found that concrete could be mixed with good results to a consistency represented by a slump of 4 in.

Unless it is certain that the grading of the premixed aggregates is proper and will remain fixed, there seems little justification for its use. The ease of handling from a single stockpile is of some advantage, but this is far outweighed by the cost of the additional cement required in the wetter concrete of equal strength, and by the increased workability of the mixture made from the separate aggregates used in the proper proportion.

There has been an almost general condemnation, in which the writer joined, of the tower and chute as a means of distributing concrete, as this method seems to require very wet mixtures and often results in complete separation of the mortar and stone. On this work, however, there has been several thousand yards successfully placed by chutes, much of the concrete being drier than any heretofore handled by other methods and delivered with no separation. Possibly the use of excess water is largely habit and probably the segregation is due to the use of improper materials poorly proportioned and insufficiently mixed.

The Abrams method of designing concrete mixtures was employed on several of the larger structures representing about 50,000 cu.yd. of concrete, and as a check test specimens are made at frequent intervals.

These test pieces are 6x12-in. cylinders, made in accordance with the A. S. T. M. Standard (Serial C-31-21) except that instead of taking the sample from the form it is drawn directly from the discharge of the mixer, so that the actual slump of the sampled batch could be measured. From three to six specimens were made for a day's run, from different batches, stored in wet sand and tested at the end of 28 days. About three hundred specimens, representing various mixes, and

slumps ranging from 1 in. to 8 in., have been broken to date, and several hundred tests will be made before the completion of the work.

The first results were disappointing; many of them showed strengths lower than expected and the others were quite erratic. While it was considered that average care had been exercised in making the specimens, investigation showed that there had been some minor departures from the recommended methods, especially in capping and storing the pieces, and after this was corrected the results were quite consistent, agreeing closely with the tables published by Prof. Abrams.

The concrete work will not be completed for several months, when additional information will be available from which more definite conclusions can be drawn, but it seems apparent:

1. That the method of designing concrete mixtures, as worked out in the laboratory, is applicable under field conditions and that a concrete of predetermined strength can be obtained with considerable accuracy, by using the proper mix and consistency.

2. That quite dry concrete, of aggregates properly proportioned, can be worked without difficulty and handled by the usual methods, and with considerable saving in cement over that necessary in the wetter mixtures of equal strength.

3. That a specification, simply defining the mix as 1:2:4 and 1:3:6, etc., without establishing some further requirement as to the consistency and grading of the aggregate, means little from the standpoint of strength as the results may vary 100 per cent, and consequently such a specification is uneconomical.

4. That better results can usually be obtained with concrete made from separate aggregates (sand and stone) than from a premixed aggregate (gravel).

5. That unless inspectors who are familiar with this method of proportioning concrete are available, it is scarcely practicable on small work as it takes them some little time to learn the mechanics of the tests, and longer to completely grasp the theory, so as to be able intelligently to vary the mix under the different conditions of weather, material, and pouring. Where frequent sieve analyses and slump tests are made it requires a good deal of the inspector's time, and on large and important work a special man to make the necessary tests would probably be justified.

The Walsh Construction Co. of Davenport, Iowa, has the general contract for the grading and masonry, and is constructing the Miami River Bridge. The work is being done under the general direction of C. A. Paquette, chief engineer, C. C. C. & St. L. Ry. Co.

Reports on Decay in Douglas Fir

Because Douglas fir is one of the most important timbers of the United States and because it is very susceptible to diseases caused by four fungi which attack it, the United States Department of Agriculture has made preliminary investigations to determine the extent of such damage and the amount of defective timber. The results of the investigations so far made have been published in the department's bulletin No. 1163, which may be had upon request from the Department of Agriculture in Washington. The facts so far established are that young stands or second growths are relatively immune from decay, but it is not yet known at what age this immunity ceases.

Sewage Distribution Tests With Butterfly-Valve Control

Variation of Pressure at Taylor Sprinkler Nozzles Obtained by Cam Control of Valve—Time-Pressure Curve

By Henry R. King
Junior Assistant Engineer, Sanitary Division, Sanitary District of Chicago

In the course of recent experiments on sewage distribution by means of sprinkler nozzles the author was impressed by the value of a butterfly valve for close control of variations in loss of head. By using the butterfly valve data can be obtained which may be more easily applied in the design of dosing tanks and other arrangements for trickling-filter control than the data which are now available. The experiments were made by the writer last year as a part of work for a thesis at the University of Illinois.

Previous experiments in sewage distribution have generally been tests of the distribution occurring with different types of nozzles when discharging at different fixed pressures. Examples of these are the recent tests

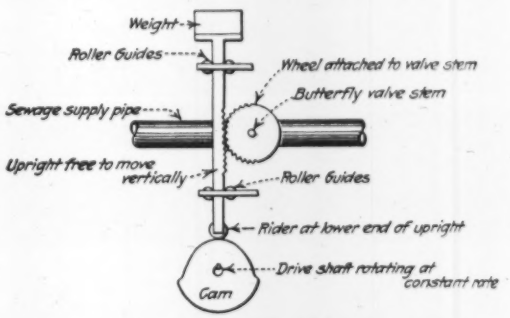


FIG. 1—METHOD OF CONTROLLING BUTTERFLY VALVE TO GIVE VARIABLE SPRINKLER-NOZZLE PRESSURE

of sprinkler nozzles by the Pacific Flush Tank Co. of Chicago and by the Purdue University testing station. The results obtained at these places have considerable value and afford examples of the best data available for designing controls for trickling filters.

Since in the operation of trickling filters a variation of pressure must occur at the nozzles to secure a uniform distribution, some difficulty arises when it is attempted to apply data given for nozzle operation at fixed pressure to conditions of varying pressure. The desired information may be arrived at by a tedious mathematical computation which has proven sufficiently difficult to result in a difference of opinion among engineers as to the proper shapes for dosing tanks.

In the sewage distribution experiments performed by the writer, a battery of three ⅛-in. Taylor circular-spray nozzles, spaced 14 ft. apart on the apices of an equilateral triangle, was used. Instead of operating these nozzles under various fixed pressures, as has been the usual practice in such experiments, a variation of pressure at the nozzles was effected. To secure this, a butterfly valve (see Fig. 1), operated by a cam revolving at a constant rate, was placed in the supply pipe to the distribution system. Sewage was supplied from a tank in which a constant level was maintained. The butterfly valve served to produce a head loss between the tank and the nozzles, the extent and variation of

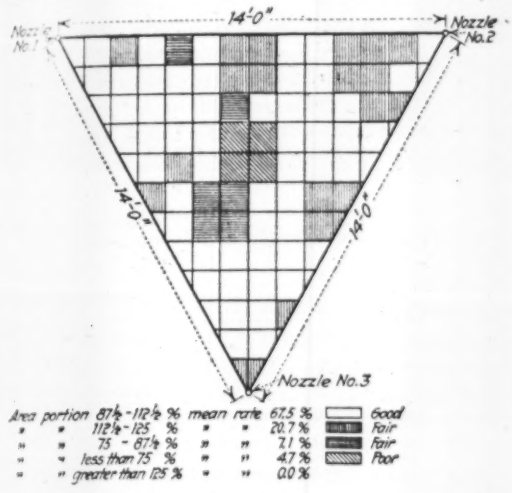

14'-0"
Nozzle No.2
Nozzle No.1
14'-0"
14'-0"
Nozzle No.3
Area portion 87½-112½ % mean rate 67.5 % Good
" " 112½-125 % " " 20.7 % Fair
" " 75 - 87½ % " " 7.1 % Fair
" " less than 75 % " " 4.7 % Poor
" " greater than 125 % " " 0.0 %

FIG. 2—RELATIVE SEWAGE DISTRIBUTION BY NOZZLES

which depended on the shape of the cam operating the valve.

To study the distribution effected, the triangular area between the nozzles was marked off into 1-ft. and smaller areas of different forms (Fig. 2). Pans, with their tops at the same elevation as the nozzles, were placed on these subdivisions. The spray that collected in these pans was measured after each dosing cycle. Distribution was considered good when between 87½ and 112½ per cent of the mean rate. For the underdosed area receiving 75 to 87½ per cent of the mean rate, the distribution was considered fair. The distribution on the remaining area was considered poor whether underdosed or overdosed.

The cam was symmetrically shaped (Fig. 1) so that the pressure at the nozzles rose from zero to a maximum and returned to zero, thus giving a symmetrical pressure-time curve. In the experimental procedure a cam was designed theoretically and tested. It was then altered until a satisfactory distribution was obtained on the triangular area between the nozzles. Fig. 2 is a graphical representation of the final distribution effected.

In Fig. 3 the head on the ⅛-in. Taylor circular-spray nozzles, spaced 14 ft. apart, is plotted in relation to time for the distribution shown in Fig. 2. The curve shows the relation of the head to the decimal parts of the total time for a variation of head from zero. The data

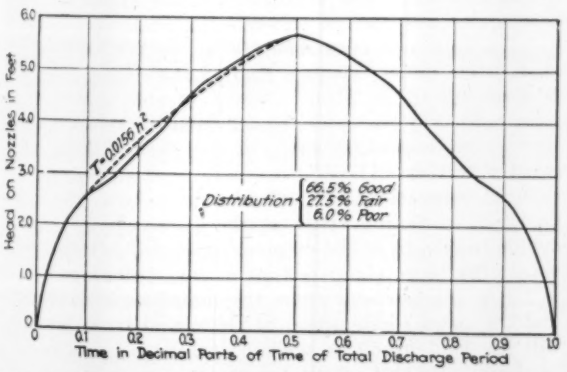


FIG. 3—PRESSURE-TIME RELATION DURING DISCHARGE PERIOD OF SEWAGE-SPRINKLER NOZZLES

Taylor ⅛-in. circular spray nozzles were spaced 14 ft. apart, as shown in Fig. 2. Each nozzle discharged 18.15 gal. in a one-minute discharge period and had 170 sq.ft. effective sprinkling area.

for this curve were obtained by noting the positions of the cam and the simultaneous pressures at the nozzles, as observed from a pressure gage connected to the distribution system adjacent to one of the nozzles. The angular position of the cam divided by the total angle of discharge gave the decimals plotted as abscissas in the diagram.

It is evident that curves similar to that of Fig. 3 for all sizes and spacings of sprinkler nozzles would be particularly valuable for designing dosing controls for trickling filters. Information presented in such form would have decided advantages over the data that are now furnished the engineer. It is the pressure-time curve in which the engineer is interested and which he must obtain to design a dosing tank properly. If such curves were provided him, together with the distribution results that had been experimentally obtained in their preparation, the design of trickling-filter controls would be considerably simplified.

The ease with which the pressure-time curves could be used for determining the proper shapes for dosing tanks is apparent from Fig. 3. The actual curve approximates a parabola. Therefore the time from zero head to any head upon the nozzles should vary approximately as some constant times h^2 for nozzles and spacing the same as used in the test. Let A equal the horizontal sectional area of the dosing tank at any distance above its bottom and T equal the time from zero head to any head upon the nozzles or from the pressure-time curve $T = k'h^2$. The rate of discharge $= k''\sqrt{h}$; $dV = Adh$; $dT = Adh \div k''\sqrt{h}$.

Taking the derivative of T as given by the pressure-time curve, $dT = k'''hdh$, and equating, $k'''hdh = Adh \div k''\sqrt{h}$ and $A = k\,h^{3/2}$. Therefore for a 14-ft. spacing of ⅛-in. Taylor circular-spray nozzles (disregarding frictional losses) the horizontal sectional area of the dosing tank should vary as some constant times its height above the nozzles raised to the 3/2 power.

Other factors would necessarily have to be considered in such a design but the general shape of the dosing tank could be obtained from the relation given.

Sewage Gate-Valve Forced Off Pump Main

A 12-in. gate-valve on the pump-well end of a branch pipe 20 ft. in length, connected with the 14-in. force main at the sewage pumping station of Natick, Mass., was recently forced off by the pumping pressure so that the contents of the entire length of the force main (6,000 ft.) and also of one sewage-bed were emptied into the pump well. The gate was on the extreme end of the branch pipe and was held in place by an ordinary lead joint, but there was a bead at the spigot end entering the gate-valve. There was no pipe beyond the gate leading into the well. The pressure ordinarily carried by the gate, which had been withstood for twenty-seven years, was about 40 lb. The gate was customarily kept closed and was opened only when it was desired to repair the force main. *Engineering News-Record* is informed by Frederic I. Winslow, Framingham, Mass., who sent the information given above, that it is probable that the action of gases from the sewage caused the lead in the joint to deteriorate to such an extent that the joint gave way. To lower the level of the sewage in the pump well, fire engines were used and the sewage was pumped to the ground so that the gate could be replaced.

Large Eyebar Suspension Bridge in South America

Span of 1,114 Feet Under Construction in Brazil Has Chain of Eyebars with New Form of Stiffening Truss

A COMBINED highway and railway bridge under construction at Florianopolis, in the province of Santa Catharina, Brazil, connecting the island on which the city is located with the mainland, represents the first application of modern eyebar-chain construction to suspension bridges. It is no less interesting because of its unusual stiffening truss construction, which, in connection with the use of eyebars for the chain and the unloaded backstays, results in a high degree of rigidity and economy. Because of its long main span, nearly 1,114 ft., this structure will take rank among the largest suspension bridges in existence. It was designed by Robinson and Steinman, of New York, as consulting engineers for Byington and Sundstrom, of São Paulo, Brazil, contractors for the bridge.

In the original design for the crossing, whose span is controlled very closely by the conditions of the site (see the location plan), a wire-cable suspension bridge was contemplated. This design had a parallel-chord stiffening truss with hangers at all panel points. When, however, the American Bridge Co. made a tender of heat-treated eyebars under a guarantee of 75,000 lb. per square inch minimum elastic limit, permitting a working stress of 50,000 lb. per square inch to be used in the chain, the structure was redesigned to take advantage of eyebar construction, with the result of showing a distinct economy in total cost and permitting the stiffness of the main span to be increased very greatly. The eyebar-chain design, shown in the drawings, is now being carried out.

Special Features—From the design details on p. 593 it will be seen that the towers are two-column steel bents with battered legs and with line bearing at the base, while the stiffening trusses have curved top chords so disposed as to give maximum depth at the quarter-points, the top chord in the middle section being formed by the suspension chain itself. This novel combination of chain and truss yields large savings in steel due to the elimination of the middle half of the top-chord and other members, and to the more economical truss outline in which the depth conforms to the variation in bending moments along the span. The traffic requirements are satisfied by a 28-ft. clear roadway width, which fixed the truss spacing at 33½ ft. Accordingly the cross-section involves no features beyond the ordinary. The backstays are unloaded, going down directly to masonry anchorages, one of which is on rock while the other is carried by a pile foundation including both vertical and batter piles. The approaches are steel viaducts with spans of 185 ft. directly adjacent to the towers.

Loading—The loadings assumed for the design of the various parts of the structure vary from 1,850 lb. per lineal foot of bridge for the chain and 2,000 lb. for the trusses (the latter with 10 per cent impact) to a 6-ton truck or 60 lb. per square foot (with 25 per cent impact) on the roadway stringers, and a 50-ton electric locomotive followed by 2,000 lb. per lineal foot (50 per cent impact) on the railway stringers. Wind was taken at 25 lb. per square foot on the suspension bridge and 30 lb. on the viaduct, and the temperature variation was taken at the moderate amount of 30 degrees rise or fall, in conformity with local climatic conditions. In comparison with these figures it may be noted that the total dead load is 4,370 lb. per lineal foot of main span, or about 4,000 lb. for structure and deck excluding the water main which extends along one side of the roadway.

With this loading the greatest allowable stresses were set at 50,000 lb. per square inch for the eyebars of the main chain, and 20,000 lb. per square inch in the stiffening trusses. Some margin below these amounts was maintained, however, and the final stresses in the chain do not exceed 46,500 lb. per square inch, and those in the trusses 18,500 lb. per square inch, as calculated by the ordinary, approximate method. In the case of the stiffening trusses, additional margin is represented by the difference between analyses of the structure by the ordinary method and by the more exact or deflection method; the latter showed considerably lower stresses, by about 25 to 30 per cent, but no reduction in section was made to suit these stresses. The reduction in the chain stress was made possible by the smaller weight of the combination stiffening truss of variable depth as compared with the parallel-chord truss. The floor framing has its bending stresses limited to 17,000. In all the analyses, the value of the modulus of elasticity of the truss steel was taken at 29,000,000 lb. per square inch and that of the eyebars was taken at 27,000,000 lb.

MAIN FEATURES OF EYEBAR-CHAIN SUSPENSION BRIDGE, FLORIANOPOLIS, BRAZIL

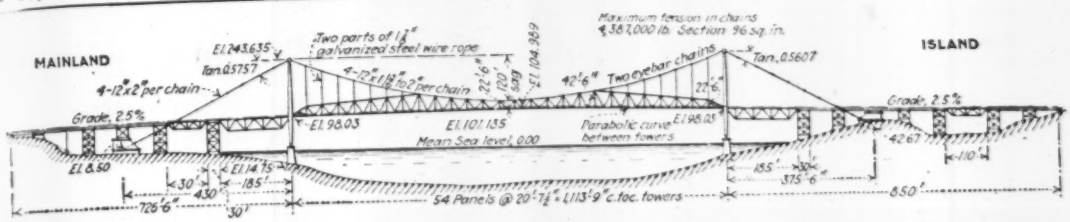
This eyebar-suspension bridge has a span of 1,113 ft. 9 in., which makes it one of the longest suspension bridges ever built. Note the unusual stiffening trusses with use of suspension chain in combination.

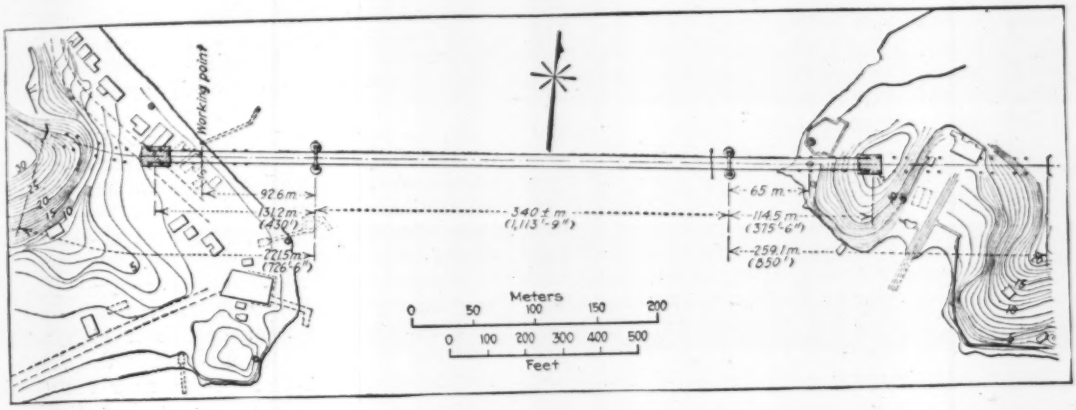
(*On page* 593)

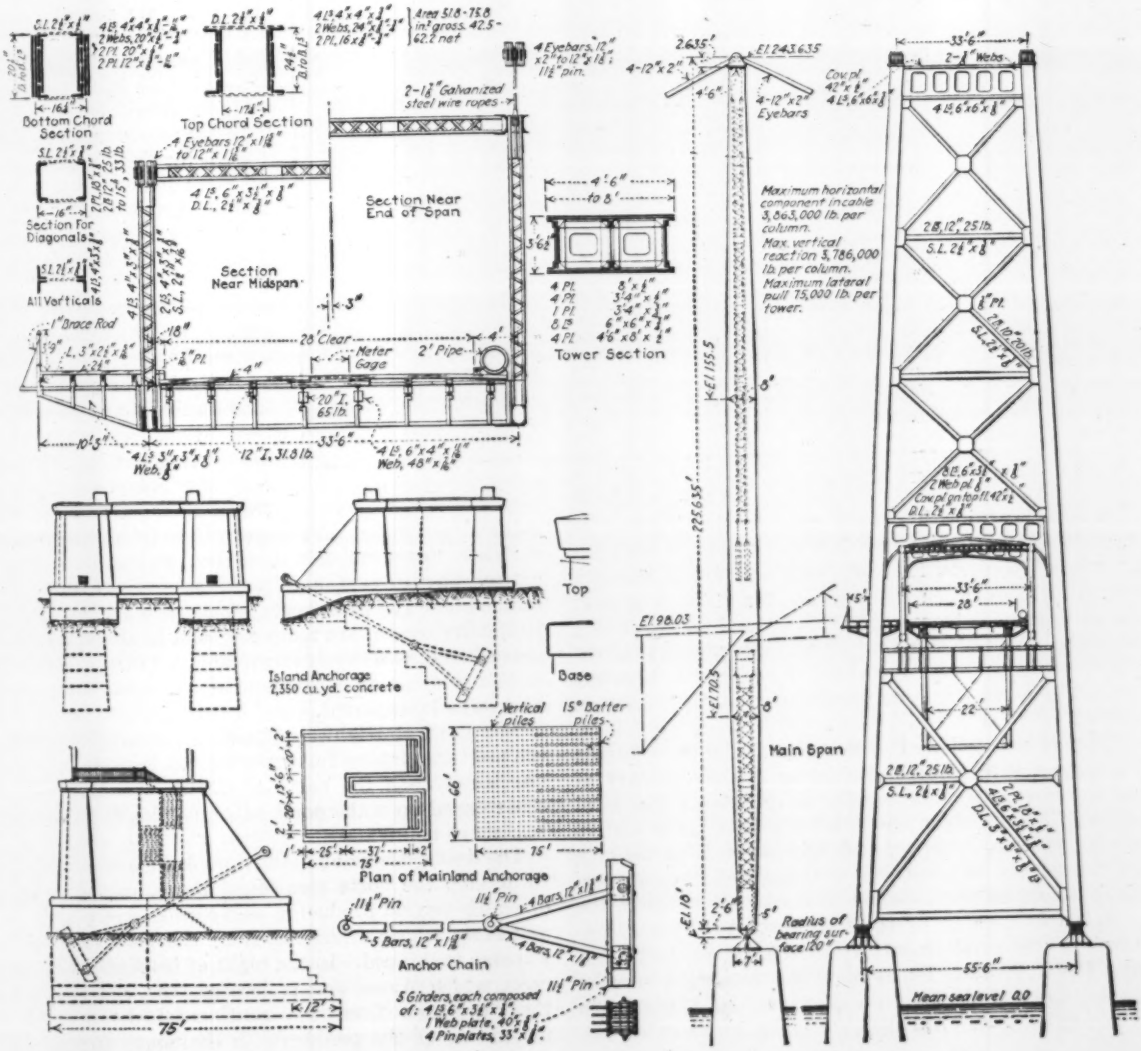
The two chains consist each of four eyebars 12 in. wide, from anchorage to anchorage. The eyebars of the backstays are 2 in. thick, while those of the main span range from 2 in. to 1⅛ in., with chain section ranging from 96 to 87 square inches. Steel-rope suspenders are used, consisting of two parts of 1⅞ in. galvanized steel wire rope socketed to clevis attachments at the top chords of the trusses.

Calculations of the deflections of the structure show that under live-load on one-half the span, the quarter-point deflection is only about 13 in., or 1/1,000th of the span, while under full-span loading the center deflection is about 17 in. or about 1/800th of the span. These extraordinarily low values result from the following factors: the use of eyebars in the chains, with their greater section and resulting greater dead weight and reduced elongation; the unloaded backstays; the great depth of stiffening truss at the quarter-points, about double the depth of the originally-planned parallel-chord truss; the large chord-section of the stiffening trusses in the middle portion, where the chains serve as chords; and the novel combination of chain and truss whereby full live-load produces tension instead of compression in the middle half of the top-chord.

Construction and fabrication are now under way and the bridge is expected to be completed by the end of next year.


MAINLAND
ISLAND
Two parts of 1¼" galvanized steel wire rope
Maximum tension in chains 4,387,000 lb. Section 96 sq. in.
4-12"x2" per chain
4-12"x1⅛" to 2" per chain
Two eyebar chains
Grade, 2.5%
Parabolic curve between towers
Mean Sea level, 0.00
54 Panels @ 20'-7½" = 1,113'-9" c. to c. towers
726'-6"
430'
850'
375'-6"


Working point
92.6 m
131.2 m (430')
340 ± m (1,113'-9")
65 m.
114.5 m (375'-6")
259.1 m (850')
Meters
Feet


Bottom Chord Section
Top Chord Section
Section Near End of Span
Section Near Midspan
Section for Diagonals
All Verticals
Tower Section
Island Anchorage 2,350 cu. yd. concrete
Plan of Mainland Anchorage
Anchor Chain
Main Span
Maximum horizontal component in cable 3,863,000 lb. per column.
Max. vertical reaction 5,786,000 lb. per column.
Maximum lateral pull 75,000 lb. per tower.
Mean sea level 0.0

Highway Construction in Panama

Traffic Growing Rapidly on Completed Roads—Bridge Building Experience—Local Labor Notably Steady and Efficient for Tropics

By R. C. Hardman
Acting Chief Engineer, Junta Central de Caminos, Panama

HIGHWAY development in Panama is drawing to the close of its first phase and is about to enter upon its second phase. The groups of roads tributary to important ocean ports, begun in 1920, will be virtually completed this year. This constitutes the first development phase. The second phase, now planned and being financed, is the extension of these isolated roads to connect with each other and with the city of Panama. Both the original and the planned routes are indicated on the map, Fig. 1.

Isolated Group Development—Feeling the necessity of transforming the nation from an importing to a possible exporting one, the National Assembly, activated by the progressive policy of the president, Dr. Belisario Porras, passed on March 13, 1919, the first of a number of laws concerning highways and the development of Panama's hinterland. This initiatory law provided for an annual contribution, or road tax, from all able-bodied males between the ages of 21 and 70, who were placed in three categories, of $12, $5, and $3, depending upon the financial standing or earning capacity of the contributor. It also provided for district highway boards to carry on minor works out of the funds so created.

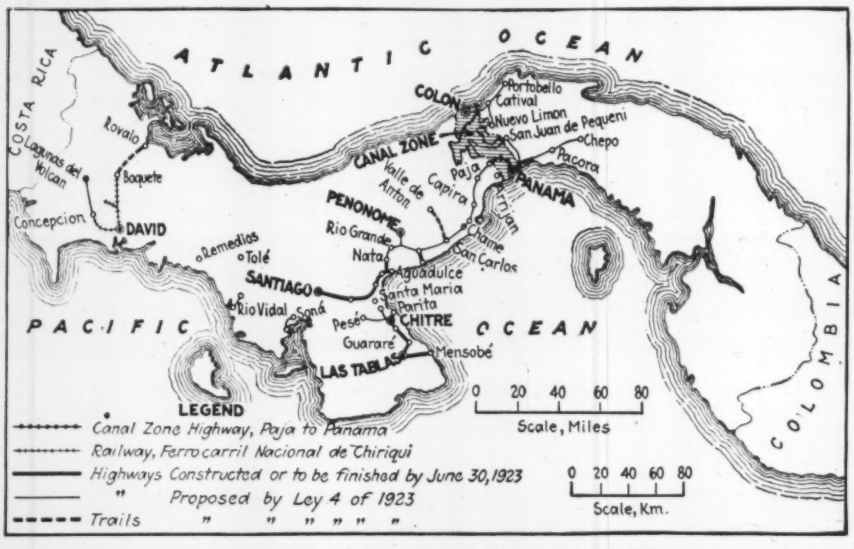


FIG. 1—HIGHWAYS UNDER CONSTRUCTION AND PROJECTED IN PANAMA

This law was followed on Feb. 6, 1920, by one creating a central highway board, consisting of the secretary of the interior and public works, as president; the fiscal agent of the republic, the chief engineer, as executive officer; and two citizens; and this board is to have in its charge the location, construction and maintenance of all roads in the republic and supervision over the local boards created by the first act. As the law contemplated the employment of a foreigner as chief engineer, the U. S. State Department was requested to make a selection and through the Panamanian Legation in Washington J. W. Beardsley, of long highway experience in the Philippines, was named for, and appointed to, the position in August, 1920. Upon his resignation in October, 1921, he was succeeded as chief engineer by R. K. West, of wide highway experience in the Philippines, California and Nevada.

In the budget for the biennium ending June 30, 1921, 75 per cent of the excess of receipts over the amount estimated in the budget was set aside as a road fund. Under the able management of Addison T. Ruan, fiscal agent for the republic, this fund at the close of the biennium amounted to $3,092,225.92.

Topographical Conditions—A word might be said concerning the topography of Panama. The narrow isthmus forming the republic has a high mountainous backbone rising to a culmination in the Volcan de Chiriquí, near the Costa Rican border, at an elevation of some 11,280 ft., and reaching a minimum of a few hundred feet at the Panama Canal. The Atlantic side is, in general, of narrow steep slopes merging into mangrove swamps, while the Pacific slope is much wider, of more gentle declivities, of rolling, grassy plains or llanos, and has a multitude of rivers. Practically all the settlement of the country is on the Pacific side and to the west of the canal. Due to the high tides of the Pacific and the shoal waters near the coast, no natural harbors are to be had. Several small ports, for shallow draft vessels at high tide, furnish the only connection between Panama and the agricultural provinces. Transportation in all the interior districts has been for centuries, and still is, almost entirely by ox-cart and pack-horse for cargoes, and saddle-horse for passengers, over roads and trails which in the dry season are mere ruts and in the rainy season seas of mud, practically impassable. As the rainy season lasts for seven or eight months, the need for passable highways is apparent.

The Central Highway Board, after careful study of the matter, adopted for improvement two sets of roads: one based upon the ports of Chitré and Mensabé, the other based upon the ports of Aguadulce and Obaldía as important points.

The first systems of roads provided for were designed to develop the ports mentioned above, in the vicinities of which several producing sugar mills are in operation, and from which a large part of the beef consumed in Panama is shipped. In the bight of the Gulf of Panama, upon which Aguadulce is located, the convergence of the drainages from the continental divide and the mountains of the peninsula to the south forms a low,

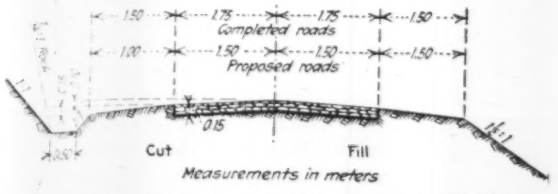


FIG. 2—STANDARD SECTIONS FOR PANAMA HIGHWAYS

flat alluvial area which is very fertile, and which is tapped by the system of roads centering on this port.

Considering the population, economics and probable future traffic, the Central Highway Board very wisely adopted the macadam type of road 3.5-m. surfaced width, with drainage structures of steel and concrete, as the most suitable under the existing and probable future conditions. Provision was also made in grade and structures, for future widening of the road when increased traffic might warrant.

History—Proposals for the two systems of roads decided upon were advertised for in January, 1921. As the board had no technical organization and it was desired to start the work without delay, bids were requested for construction and also for surveys and plans, on the basis of cost-plus-a-percentage, with bonus and penalty clauses. Awards were made to R. W. Hebard & Co., New York, for the Aguadulce system and to the Panama Construction Co., Panama, for the Chitré group, and the work of surveying started in April, 1921, on both divisions.

Each division, sub-divided into four sections, comprised in all, about 135 km. of road. Due to various causes, among which was the business depression and transference of funds to other branches of the government, of the 270 km. in the two divisions, only about half of the proposed program has been authorized and is actually under construction.

In addition to the work in the interior provinces, there was planned a highway from the city of Panama to Juan Díaz, with a short branch to the ruins of Old Panama, which was destroyed by Sir Henry Morgan in 1671. Of this section, 3.37 km. are of concrete, 6 m. in width; 5.30 km. of bituminous concrete, 5 m. in width, and 10.60 km. of oiled macadam, 3.5 m. wide. This is the only highway out of Panama on Panamanian territory and affords an outlet for the rich agricultural districts to the east which have been lying dormant because of a lack of transportation facilities. As an indication of what may be expected in the way of development, a comparison of present traffic on this road with conditions of two years ago is enlightening. The writer, early in 1921, went to Juan Díaz in an automobile, engaged after considerable effort, for $7.50. In the last week of March, 1923, a traffic count at Juan Díaz showed a daily average of 231 motor vehicles, with a maximum of 372 and a minimum of 163. The fare in any one of a number of motor buses is now 50c. for the round trip. On the first or concrete section of this road, the daily motor-vehicle average count was 1275.1, with a *total motor-vehicle registration of but 1,220.* The maximum for this section was 2,942 and the minimum was 853.

Types of Roads—On the interior roads, which are not yet fully completed, equally remarkable traffic increases are expected. Where two years ago motor-vehicles (other than airplanes) were unknown, large numbers of passenger cars and light trucks are in operation, and bus services between towns, which are already connected, have been established.

The roads at present being completed in the interior are, as before stated, of the light-surface type, macadam or gravel with permanent structures of concrete and steel. The width of surfacing adopted was 3.5 m. on a grade width of 6 m., shoulder to shoulder. Structures, however, were designed for a 5 m. clear width, with the exception of long steel spans which are 4 m. This clearance on steel spans was fixed partially by that of some long steel spans already existing on the adopted routes and by the large number and consequent great cost of steel bridges required on the proposed work.

The typical cross-section of the road is as shown in

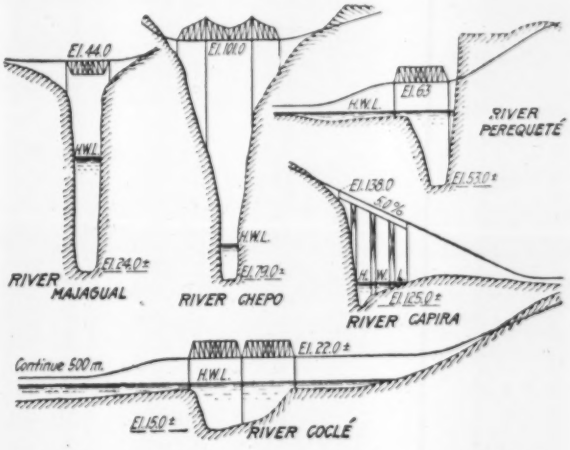


FIG. 3—TYPICAL STREAM SECTIONS AND BRIDGES

Fig. 2. The width of surfacing, as well as its thickness, was the subject of much discussion and study, and those adopted, after a year's observation since the completion of certain portions of road, have been proven to be ample for the amount and weight of traffic.

Construction in the main has been largely by hand labor, especially on earthwork. Mechanical equipment for earth moving has not shown the most favorable results due to the lack of capable operators. A certain amount of patience is necessary to secure the interest of the local operative candidates. One crew has been developed for use on a blade grader drawn by a 40-hp. tractor which has performed very satisfactory service, and with additional practice and training excellent results may be expected. One favorable feature is that the native becomes a steady worker after learning the use and object of mechanical appliances.

Considerable difficulty was anticipated in securing common labor in the provinces, but happily without justification. A steady reservoir of labor has been available, which, although untrained in any but agricultural work, has proven itself fairly adaptable and efficient. Studies made for the year 1922 show that the attendance efficiency of hourly men, measured in terms of hours worked to possible hours of work, has a steady increase throughout the year. Aiding in this was the medical and sanitary supervision exercised by the contractors and an uncinariasis campaign carried on by the Rockefeller Foundation over a part of the period. The common labor is also very quiet and manageable, which in itself tends to increase efficiency in attendance.

Efficiency in output has been good for tropical labor;

FIG. 4—ASPHALT ROAD NEAR PANAMA

especially is this true on task work. On excavation in ordinary earth, tasks of four to five cubic meters are given, depending upon conditions. The average task laborer moves 5 cu.m. in from seven to eight hours. Quarries operated by task labor show an output of about 7 cu.m. per man per nine-hour shift.

An interesting experiment was made with a small gang on earth borrow to determine the merits of the task system. The results were startling. Twenty-one men under a native sub-foreman moved 8 cu.m. in 9 hours. Five of the same men the next day moved 23 cu.m. in the same period by task.

Proposed New Development—As the roads now completed and under construction in the interior are merely for the development of the country adjacent to the ports, their full purpose will not be realized until the systems are connected to each other and to the capital, Panama. Panama, in common with all other undeveloped nations, is distinctly provincial in nature, due entirely to lack of means of transportation between the integral parts. Consequently proper united action for the benefit of the country as a whole is difficult, and only by furnishing connections can unified action be expected. Realizing this, the president, Dr. Belisario Porras, has secured the necessary legislation for the floating of a loan to cover the cost of bringing the present roads to the capital.

The map, Fig. 1, shows the roads already constructed and to be finished by the end of the fiscal year, and those proposed to be built with the proceeds of the authorized loan of $4,500,000, negotiations for which are now under way.

From the point where the present construction stops, at Natá (founded in 1519) to the Canal Zone boundary is approximately 160 km., over a terrain extremely varied, running from low, alluvial river bottoms, through high, grassy plains, broken and eroded waste lands, to high, fertile jungle-covered hills at its terminus at the Canal Zone boundary. Unfortunately, during the construction of the Panama Canal, no provision was made for a permanent crossing, so that now no means exist for transportation from one part of the republic to the other except by water, or by horse across the lower guard gates on the locks. Consequently, a system of highways such as is contemplated, will be defeated in its purpose without the co-operation of the United States government in providing a permanent crossing of the canal and the constructing of a highway from the canal to the boundary. That such co-operation will be given is not to be doubted, as the military value of the work will equal, if not transcend, its economic importance, not only by enabling the rapid movement of the troops over a now practically impassable region, but by the much greater factor of opening up territory to the cultivation of foodstuffs sufficient to sustain the military and civilian population in case of possible blockade by an enemy fleet. Under present conditions, due principally to a former policy of isolation and the depopulation of the Canal Zone, contiguous to the only available transportation—the Panama Railroad—practically all foodstuffs are imported from abroad, or are brought to Panama by water.

The proposed road connecting Natá with the capital presents some difficult terrain, the Natá end for several kilometers being through river bottoms subject to overflow and necessitating practically a continuous fill for about 15 or 16 kilometers. It then merges into a high, grassy plain gradually changing into waste lands characterized by deep, badly eroded gullies and deep, narrow stream channels. In 9.6 km. of this section there will

FIG. 5—TYPICAL LABORERS' CAMP

be eight stream crossings with some 640 m. of steel bridges—nearly 7 per cent of the distance. Leaving this broken country, the line crosses high, jungle-covered hills near Capira, merging again onto grassy plains in the vicinity of Chorrera from which point the wooded hills continue to the Canal Zone boundary.

Owing to the extremely broken topography along streams, in some cases 10 per cent grades are necessary for short distances, while on the Capira hill section 7 and 8 per cent grades are required to reach the summit of the entire line which is at 203 m. above sea level. In general, no grade will exceed 7 per cent. The maximum curve planned is 40 deg., metric-radius about 29 m., although this may be exceeded in some unavoidable instances.

Owing to the nature of isthmian topography, which in the hill sections is made up of numberless small round-top hills with no semblance to order or regularity, the alignment is not simple, although in the plains sections tangents several kilometers in length are easily obtainable.

FIG. 6—"CASCAJO" ROAD NEAR AGUADULCE

"Cascajo" means "gravel," but the soil near Aguadulce which is composed of clay, feldspar, decomposed feldspar, hematite and limonite is also so called.

On the entire route from Natá to the Canal Zone, the projected line shows a total of over 2 km. of steel structures in a distance of about 165 km., having an estimated weight of some 1,600 tons. This work presents the greatest construction difficulty, as transportation in a territory devoid of roads is a serious problem. Not only must steel and cement be hauled from the ports, but in many cases stone, gravel and sand must also be transported long distances. Sand in some sections is unobtainable, in others practically a pure quartz sand is found in large quantities.

Cross-sections of five of the 38 major streams to be crossed in the 165 km. are shown in Fig. 3. These show the three types of stream, the deep, narrow gorge of the waste lands district, the unbalanced bank type of the hill sections, and the low overflow stream of the plains area. Cantilever spans are proposed for some of the wide, deep gorges, as timber for falsework is not available locally and imported sawed timber is almost prohibitive in cost.

Streams of the type of the Capira and Perequeté are usually at the foot of long heavy grades, on the high bank side, that at the Capira being approached by 1,340 m. of an average grade of 4.85 per cent.

The surfacing problem is a difficult one as good rock is very scarce and gravel is even more so in certain sections. Several kilometers of roads now under construction have been surfaced with a soil known locally as "cascajo," which is found over an area of several square kilometers and is composed of clay, decomposed feldspar, hematite and limonite. The material when taken out is yellow, but after a few days on the road becomes an iron oxide color, very hard and practically impervious. In other sections is found a sand-clay mixture which with some addition of sand will form the hard or Class A material of the State Highway Testing Engineers and Chemists conference. In the hill sections, suitable stone is available with reasonable hauls.

Of the other proposed roads, those out of the city of Colon will be the most beneficial, opening up as they will some very productive lands. The short road from the end of the railroad in the western end of the country will tap some very fertile lands on the slope of the Volcan de Chiriquí, which have recently been acquired by a large group of colonists from southern California. The route to Chepo to the east of Panama is but an extension of the road for which some traffic statistics have been given above, and with the western extension to Santiago will provide a continuous road from east to west of some 320 km. through a region which is expected in the near future to place Panama on the list of exporting nations.

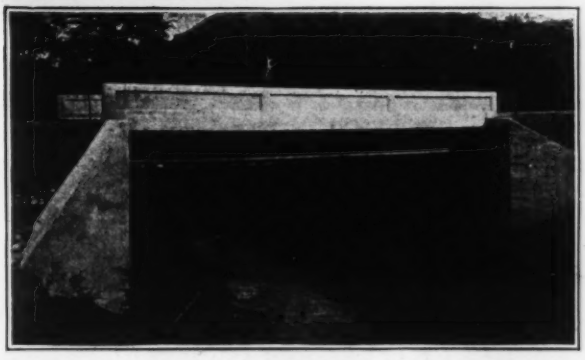


FIG. 7—TYPICAL REINFORCED-CONCRETE GIRDER SPAN ON NEW WORK

Old bridge visible in background.

Since the beginning of the highway work two years ago, great enthusiasm has developed along highway lines; enthusiasm which has in many instances resulted in work being done on short connections by voluntary contributions of labor and transportation.

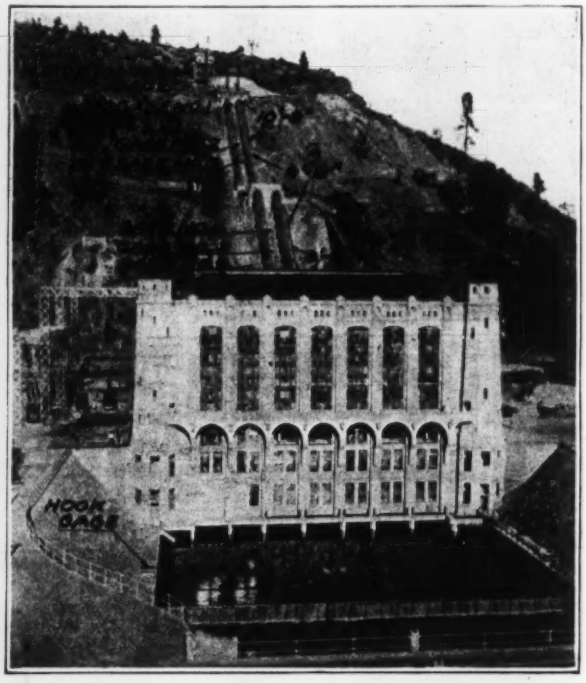
The personnel of the organization handling the highway work is J. M. Fernández, secretary of interior, as President; R. K. West as chief engineer; F. H. Baldwin, sub-fiscal agent for the republic; Rafael Neira A., and Gregorio Miró, members, and Alfredo O. Boyd, secretary. Credit for assistance on financial lines must also be given to Eusebio A. Morales, secretary of the treasury.

Test of Friction Losses Made on Large Penstocks

Ideal Arrangement for an Accurate Measurement of Large Quantities of Water—Tests of Friction Losses in Tunnel

Summary of a paper on Tunnel and Penstock Friction Tests, Pit No. 1 Hydro-electric Development, presented at the P.C.E.A. Convention, June, 1923, by R. A. Monroe, Department of Engineering, Pacific Gas and Electric Co.

AN IDEAL opportunity to make an accurate determination of pressure tunnel and penstock friction losses is offered by the arrangement of the Pit No. 1 Development of the Pacific Gas and Electric Co., particularly as two parallel penstock lines afford a ready means of measuring the penstock friction, and an accurate measurement of the large quantities of water utilized is afforded by a standard weir located at the lower end of the stilling basin in the power house tailrace. The upper portion of Pit. No. 1 penstock is composed



LOCATION OF PENSTOCK AND WEIR GAGES

of butt strap riveted pipe, and the lower portion of lap-welded bump-joint pipe so that it is possible to obtain a direct comparison of the loss in these types of pipe.

The conduit for Pit No. 1 power house consists of about 1,000 ft. of open canal, 10,160 ft. of concrete lined pressure tunnel and 1,372 ft. of steel penstock. The tunnel is connected to the penstocks by a surge chamber which consists of a circular well 60 ft. in diameter and over 60 ft. in depth designed to serve also as a spillway. The water after passing through the turbines is discharged into a stilling basin and measured over a weir before passing through the tail canal into the Pit River.

Tunnel Friction Tests—The tunnel is of horseshoe section 14 ft. 3 in. high by 13 ft. wide and has an area of 156 sq. ft. and a hydraulic radius of 3.42 ft. At a point about 1 000 ft. from the upper portal, there is an angle of 36 deg. From this point to the surge chamber the tunnel is on tangent. The section for 400 ft. from the surge chamber is circular with a diameter of 14 ft. having a flaring section where it enters the surge chamber.

The surface of the tunnel lining is not particularly smooth and even. Wood forms coated with oil when first constructed were used for the side walls and roof. After the forms were stripped, the rough patches and stone pockets were plastered over and the entire area brushed over with a neat cement grout which resulted in a smooth, almost glazed finish. Ordinarily, the alignment of forms was very good and in cases where excessive offsets occurred they were chipped off. The invert was placed by hand without forms and presents a rather rough uneven appearance.

For securing the loss of head in the tunnel, the difference in water level between the intake canal at the tunnel portal and the surge chamber was taken. The water surface elevation at the intake was obtained from a staff gage fastened to the vertical wall of the portal structure immediately above the grizzly. At the outlet portal of the tunnel the surge chamber served as a huge manometer in which all small fluctuations were damped and close readings were made possible by an attached water gage. These gages were set on U.S.G.S. datum to read actual water elevations.

The loss of head in the tunnel was determined by a simultaneous reading of the gates at the intake and surge chamber after steady flow conditions had been established. For the lower flows the excess water in the river was turned out at the intake dam so that no spill existed at the surge chamber. The water level at each end of the tunnel oscillated for a considerable period after any change in flow, and it was necessary to hold a steady load at the power house for an hour or more before steady conditions were obtained. The discharge was measured by the weir for quantities up to 1,000 sec.-ft., and by current meter measurements in the intake canal for larger flows when the weir became submerged.

The computations of tunnel friction are based on the assumption that the head lost in entrance is balanced by the regained velocity head at the surge chamber and that the balance of the velocity head is lost in the surge chamber or is carried into the penstocks. This assumption may not be correct but the resulting error in any case is negligible. Data and results are as follows:

Flow	729	sec.-ft. Kutter's coefficient	n = .0130
"	997	"	n= 0128
"	1,280	"	n = .0126
			Mean = .0128

The tunnel was designed on a basis of n = .014, which has proved conservative.

Penstock Friction Tests—The Pit No. 1 penstocks consist of two lines of pipe, each composed roughly as follows:

281 ft. of 10 ft. 9 in. diameter triple riveted butt joint steel pipe;

532 ft. of 9 ft. diameter lap-welded bump-joint steel pipe;

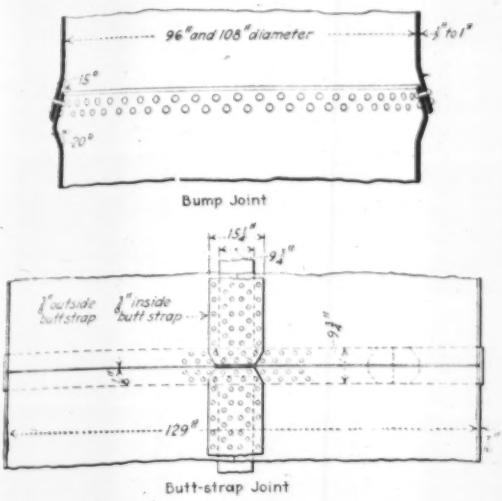
433 ft. of 8 ft. diameter lap-welded bump-joint steel pipe

These sections of pipe are connected by taper sections averaging about 30 ft. in length, the entire length of the penstock being 1,372 ft.

There are no horizontal angles in the penstock except at the entrance to the powerhouse tunnel where the two pipes diverge slightly. There are five vertical angles, averaging about 20 deg. each, two being in the 9 ft. diameter bump-joint pipe and three in the 8 ft. diameter bump-joint pipe.

The penstock friction tests were made by means of a differential U-tube gage connecting the two pipe lines one of which was idle and the other under flow. One arm of the U-tube was connected to the idle penstock, this arm being under static pressure, while the pressure on the other arm was reduced by the velocity and entrance head and the loss due to overcoming friction. The deflection of the U-tube multiplied by the difference in specific gravity between the water and the mercury gave directly the reduction in pressure from static in the operating pipe at the point of observation, the difference in deflections of the mercury column between any two gage boards being a measure of the head lost in that section of the pipe.

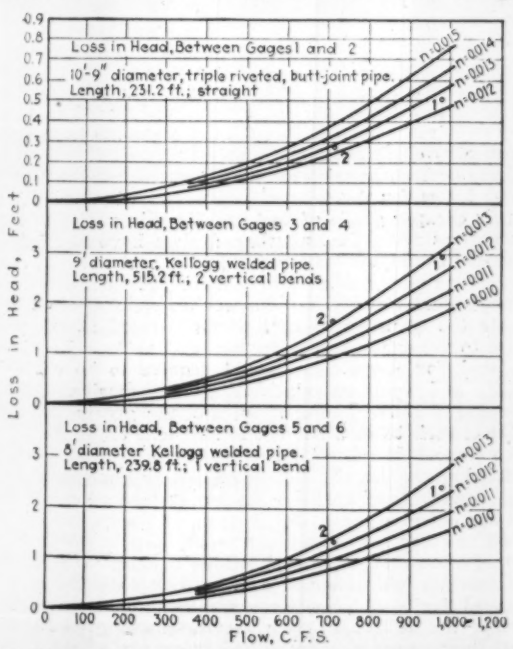
Each penstock was drilled at six correspondingly opposite points throughout its length and tapped for ½ in. piezometer connection. The points were selected to be as near as possible to the upper and lower ends of each diameter of pipe. The upper point, 1, was placed directly below the top penstock anchor. The next two points, 2 and 3, were placed



DETAILS OF PENSTOCK JOINTS

above and below the 10 ft. 9 in. to 9 ft. 0 in. taper respectively. Points 4 and 5 were placed above and below the 9 ft. to 8 ft. taper respectively. Point 6 was placed near the lower end of the 8 ft. diameter pipe.

Before starting the penstock tests, water was allowed to run through the idle penstock for a short time in order to make sure that the temperature of the water in both penstocks was the same and avoid the necessity of correcting for temperature. The operating machine was then brought to a steady load and held there until uniform flow conditions were established throughout. Before making a series of readings, dead water and air in the pipe connections were blown out through the pet cocks on the gage boards and the surge in the penstock was throttled by the needle valve in the steam gage fitting at the top of the board. The position of the mercury meniscus on each arm of the U-tubes was read and recorded. From four to five readings at intervals from 1 to 2 minutes were made at each station, the time of each reading being recorded. It was found that by throttling the surge with the needle valve the U-tube deflections could be estimated to thousandths of a foot. A signal



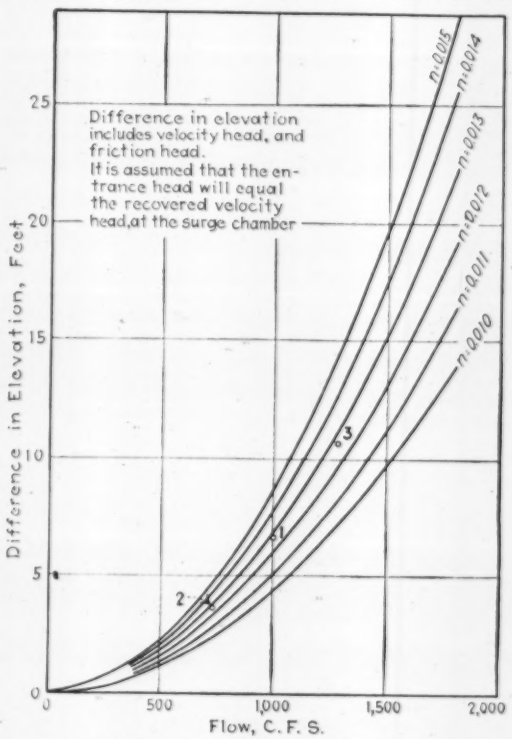
LOSS IN SECTIONS OF PENSTOCK FOR VARIOUS FLOWS ASSUMING VALUES OF "N" IN KUTTER'S FORMULA

system was used so that the recorded deflections for each were made simultaneously. Both weir hook gages were read at approximately 5-min. intervals throughout the test, and the electrical output of the generators also served as a check on the quantity of water measured.

Two series of penstock tests were made, one with the generator carrying full load under a flow of 982 sec.-ft. and one with three-quarters load and a flow of 714 sec.-ft.

Tap 5 on the penstock had been placed within 9 in. of a bump joint and the deflections at this point were all in excess of what they should have been on the basis of the velocity head loss through the taper between gages 4 and 5, plus the friction loss in this distance, based on the value of "n" in Kutter's formula as determined in the 9-ft. diameter section.

A check on the measurements of friction loss for the several sections of pipe is afforded by the loss in head for the entire line as indicated by the power house pressure gage


Difference in elevation includes velocity head, and friction head.
It is assumed that the entrance head will equal the recovered velocity head at the surge chamber
n=0.015
n=0.014
n=0.013
n=0.012
n=0.011
n=0.010
Difference in Elevation, Feet
Flow, C. F. S.

DIFFERENCE IN ELEVATION BETWEEN TUNNEL PORTALS FOR VARIOUS FLOWS AND VALUES OF "N"

readings, there being one such gage on each penstock. This check is extremely rough, an error of a foot or more being quite possible due to the coarseness of graduation and the vibration of the indicating needle. The results were:

Flow Sec.-Ft.	Friction Coefficient	10 Ft. 9 In. Riv. Pipe	9-Ft. Bump Joint	8-Ft. Bump Joint
714	Kutter's "n"	0.0128	0.0131	0.0127
	Williams-Hazen "C"	120	113	115
982	Kutter's "n"	0.0125	0.0127	0.0123
	Williams-Hazen "C"	120	114	115

From the results obtained for the penstock pipe it would appear that the 10 ft. 9 in. diameter riveted steel pipe had a slightly lower coefficient of roughness "n" than the 9 ft. diameter lap welded bump joint pipe. The section of riveted pipe tested was of large diameter and straight between the gages while the welded pipe had two bends of about 20 deg. each in the length between the gages. No satisfactory data for loss of head in bends in large pipe are available but it is evident that for large diameters welded and riveted pipe are practically on a par as regards friction loss and that a value of $n = 0.013$ in Kutter's formula or $C = 115$ in the Williams and Hazen formula can safely be used for new pipe. The excessive U-tube deflection at Point 5 placed 9 in. from a bump joint indicates that there is considerable disturbance of the water in the vicinity of the bump joints.

Suburban Electrification at Melbourne, Australia

Multiple-Unit Electric and Steam Main-Line Trains on Same Tracks of 145-Mile 1,500-Volt D. C. System Completed in 1923—Economic Results—Quicker Service Increases Traffic and Revenue

IMPORTANT IMPROVEMENTS in train service and operating expenses have resulted from the electrification of the extensive suburban system of the Victoria Government Railways at Melbourne, Australia, which electrification was completed over the entire system early in 1923. Notable features in this new installation are the operation of suburban electric and main-line steam traffic on the same lines; the higher speed and better service at lower cost, resulting in increase in traffic and revenue; the adoption of through routing instead of having all trains terminate at the city station; and the supply of current in large quantities by the railway power plant for general power purposes. All trains have American motor, electrical and brake equipment.

This suburban system includes 145 miles of line

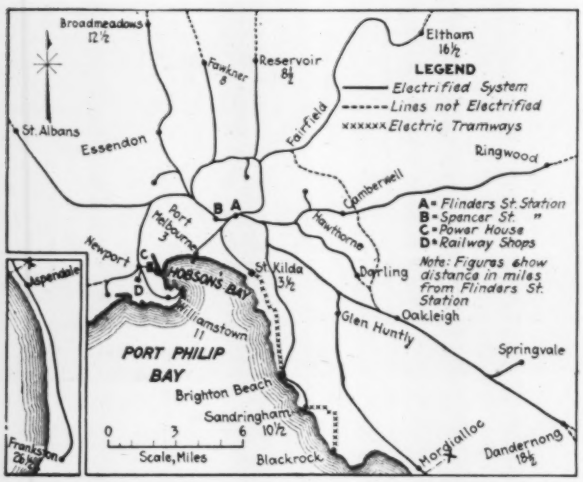


FIG. 1—ELECTRIFIED SUBURBAN LINES AT MELBOURNE, AUSTRALIA

with 346 miles of track. From the map, Fig. 1, it will be seen that the system consists of a number of radiating lines which extend through numerous residential districts and to a maximum distance of 26 miles from the central passenger station at Flinders St. There are about 2,376 electric suburban trains daily in and out of this station and approximately 240,000 passengers are handled daily. With main line and freight trains the total daily traffic at Flinders St. is about 2,640 trains. Electric traction is only for the suburban traffic; main-line trains will continue to be operated by steam locomotives over the electrified portions of the railways, but main-line electrification is being considered by the Railway Commissioners.

Electrification of the suburban service was authorized in 1912, when the traffic had developed to such an extent as to necessitate either additional tracks to increase the capacity for steam traction or a change to electric traction to increase the traffic capacity of the existing tracks. Contracts were let and work was commenced in 1913, but war conditions caused protracted delay and increased the cost considerably. The first electric train was run in May, 1919, between Essendon and Sandringham, a distance of eighteen miles, and since then the work has proceeded rapidly, so that in June, 1922, about 80 per cent of the suburban traffic was operated by electric trains.

Supply of current at low prices for power purposes is an important feature of the project, since the peak demand for railway service is reached only during the short rush-hour periods of morning and evening. A steadily increasing cost of coal is a factor in the economy due to electric service. Thus the original estimates showed an economy when the price of coal was about $2.50 per ton, but in 1919 the price had increased to $4.60 per ton delivered at the power station. The total expenditure to June 30, 1922, was $27,484,200, which was expected to be increased by $3,250,000 before completion. On the other hand, some of the expenses were properly chargeable to such accounts as general power supply, line improvement and signaling, so that the final cost for electrification will be reduced accordingly.

Economic Results of Electrification—In the annual report of the Victorian Railways Commissioners for the year ending June 30, 1922, the results obtained were presented as follows:

A marked increase in business has resulted from the electrification of the various lines. The economic efficiency of electric train operation compared with steam locomotive working has made possible an average increase of about 35 per cent, as compared with the previous steam train time-tables, in the total number of trains scheduled, the cost of which under steam traction would have been prohibitive. The fast and frequent electric train service now provided during the slack hours has encouraged considerable additional traffic. On 95 miles of electrified line, out of a total of 145 miles, the extra traffic due to electrification (after allowing for the normal expansion that would probably have occurred had steam traction continued and for other factors) is valued at approximately $850,000 per annum, while the increase in the number of passenger journeys is estimated at 12½ per cent. Present indications are that the annual interest on the scheme will be offset by the increased traffic induced through the improved train service afforded by electrification.

Local or Wonthaggi slack coal is utilized at the Newport power house for the generation of electricity, and the use of this cheaper grade of fuel and the elimination of steam locomotives from the suburban system have enabled considerable savings to be effected in the cost of train operation. It is estimated that to run the present electric train mileage under steam conditions would require approximately double the quantity of coal now consumed at the power house to generate current for train operation. In addition the coal for locomotives would require to be of higher quality and would be relatively more expensive, while the advantages of the higher speed and the greater flexibility of the electric train would not be available under steam.

An important advantage of the electrification scheme is that it has enabled the central station at Flinders St. to be used largely as a through station instead of a terminal, and has deferred costly duplications of tracks and the provision of other facilities which would have involved expenditures amounting to several million pounds. If electrification had not been adopted, a large outlay would have been required for new locomotives and additional carriages to operate the suburban train services; and even then the great improvements in speed and frequency afforded under electrification would not have been practicable had steam working been continued.

The original project of establishing a railway traction scheme has developed in another highly important direction, namely, the supply of power for industrial purposes. The total monthly output from the Newport power house is now approximately 14,770,000 units, of which 6,400,000 units are being sold for other than railway purposes.

Electric System and Power Station—A 1,500-volt direct-current system was adopted, since a comparison of alternative bids for systems using 1,500-volt direct-current and 11,000-volt single-phase alternating-current indicated that the former would be about 23 per cent lower in first cost and 22 per cent lower in annual operating expenses.

The power station of 100,000 hp. capacity is located at Newport, near the mouth of the Yarra River, an arm of Port Phillip Bay, since the requirement for condensing water is about 6,000,000 gal. per hour when working at maximum capacity. Structural steel framing is used for the building, with walls of cement plaster on expanded-metal lathing. It is U-shaped in plan, with the turbine room and switch room extending across the full width and with two boiler rooms forming the legs. A low structure between the boiler rooms contains laboratories, store rooms and locker and toilet rooms. Beyond each boiler room is a coal pile straddled by a steel trestle on which travels a locomotive crane handling a grab bucket. There is ample space for a proposed duplicate power house.

Six turbo-generators of 12,000 hp. constitute the present main power equipment, with two 350-kva. machines for starting the auxiliary apparatus when all the main turbines are shut down. Room is provided for two more generating units. Steam is supplied by twenty-four water-tube boilers carrying 210-lb. pressure, each boiler room having twelve boilers in six batteries on opposite sides of a central firing room, with a low smokestack to each battery.

Coal from 15-ton drop-bottom cars is dumped into a track hopper and after passing through crushers is fed to bucket conveyors which deliver it to overhead bunkers of 3,000 tons total capacity or to the coal storage yard. This storage coal is reclaimed by the locomotive crane mentioned above and delivered to conveyors for filling the bunkers. Suction conveyors remove the ashes, but narrow-gage tracks with ½-ton cars are provided for emergency.

Transmission Cables and Trolley Wires—Current generated at 3,300 volts is transformed to 20,000 volts for transmission to fifteen substations where it is transformed to 1,500 volts for delivery to the overhead wires. Another substation controls supply to the railway shops and two 600-volt substations provide for current supply to the St. Kilda & Brighton and Sandringham & Blackrock electric tramways (Fig. 1). In the city the transmission lines are laid mainly in trenches in the streets, owing to the limited space along the railway tracks, but in outlying districts they are carried on brackets on the poles for the overhead wires, as shown in Fig. 2.

Overhead contact wires or trolley wires are suspended from catenary cables carried by light steel bridges 300 ft. apart, with tension devices on anchor bridges at intervals of 3,000 ft. At each bridge the wires are held from swaying by horizontal arms or pull-offs attached to the posts. For curves, one pull-off is attached to a rigid vertical member depending from the bridge, as in Figs. 2 and 3. For double-track these bridges have tapering posts composed of two 6-in. channels with web lacing and a top member consisting of two 6-in. channels with attachments for the catenary cables (Fig. 3). For more than two tracks a light horizontal truss is used, with hangers to carry the catenary cables. For long spans and the complicated wiring over station approaches, two-hinged "arch" trusses are used, having vertical side members resting on shoe pins. The largest of these "arch" bridges, shown in Fig. 3, has a span of 120 ft. and a truss depth of 7 ft., with the bottom chord 30 ft. above the rails.

Since the catenary cables serve as feeders they are electrically connected to the trolley wires at 600-ft. intervals, owing to the low conducting power of the hangers, which have a chain link connection to the wire to allow for vertical motion caused by the passage of the pantagraph collectors on the motor cars. These cables are of copper for the main tracks and of galvanized steel for the side tracks and yards. At the Flinders St. station, four double-track main lines pass

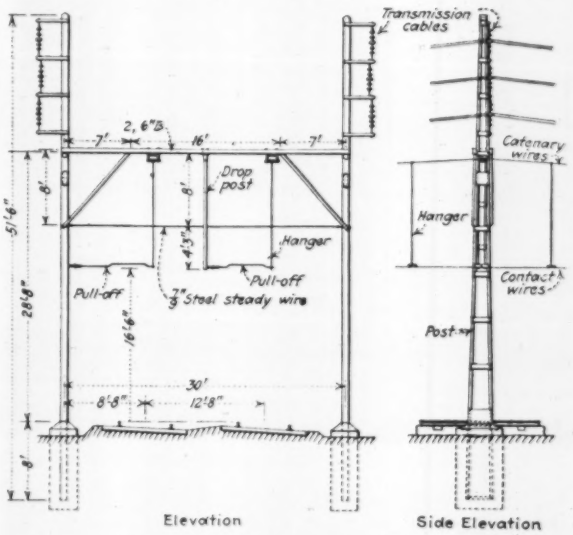


FIG. 2—BRIDGE CARRYING TROLLEY WIRES AND TRANSMISSION CABLES

through the coach yard, and here the catenaries for the yard tracks are carried by transverse wires attached to the cable bridges over the main tracks.

The contact wires have a normal height of 16½ ft. from the rails, with a maximum of 18 ft. at road crossings and a minimum of 14½ ft. under highway bridges. This minimum gives a 4-in. clearance above the maximum limit of main-line equipment and 12-in. below the bridge structure. At low bridges the supports are placed out of the line of the blast from steam locomotives.

Track and Terminals—All tracks are of 5 ft. 3-in. gage and are spaced 11 ft. 8 in. or 12 ft. 8 in. c. to c. Track construction consists of 80-lb. and 100-lb. rails spliced with six-bolt angle-bars and spiked to hardwood ties 10x5 in. and 9 ft. long in 1½-in. stone ballast 10 in. deep under the ties. The tie spacing is 34 in. c. to c. or 20 in. at rail joints. These lines are mainly double-track, but with some four-track and six-track stretches and about twenty miles of single-track. The maximum grade is 2 per cent and the sharpest curves are 10 deg. on the viaduct approaching the main passenger station at

Flinders St. Transition curves are used on all sharp curves. Automatic three-position block signals of the semaphore type are used (Fig. 3).

There are two important city stations, the principal one, at Flinders St., having thirteen through tracks in alternate groups of three and two with four island platforms and two side platforms. These station tracks converge into a four-track approach at each end. A few blocks distant is the Spencer St. terminal station, with two through tracks and twelve stub tracks. All stations have high platforms. At the suburban stations the platforms are usually for six-car trains but these are being lengthened for eight and ten cars.

Train Equipment and Service—Multiple-unit trains are used for the suburban service, composed of 47-ton motor cars with and without driver's compartment and 27-ton non-motor trail cars. Each train has alternate motor cars and trailers. Six-car trains are operated ordinarily, but provision is made for longer trains. Although the cars are of 5 ft. 3 in. gage, they and their electrical equipment are so designed as to admit of a future change to the 4 ft. 8½ in. gage.

About half the cars are a combination of American and European types, having transverse seats and a center aisle, but with sliding side doors; transverse bulkheads with sliding doors divide the cars into first- and second-class sections and smoking rooms. The other cars are of the European type with transverse compartments and swinging side doors. All cars are mounted on four-wheel trucks. Their seating capacity is 80 and 84 passengers for motor cars and 90 and 94 passengers for trail cars. Each motor car has four 140-hp. motors and a pantagraph collector operated by compressed air; the collector is fitted with renewable copper wearing plates filled with graphite grease.

Electric trains have been introduced gradually and steam trains correspondingly retired. An average increase of 30 per cent in speed is one result, owing largely to the rapid acceleration with electric trains, so that the time of the various trips is reduced by three to eleven minutes. The maximum speed capacity on level track is 52 m.p.h. All trains are equipped with Westinghouse brakes. A 2-minute service is operated on some of the inner lines, and from 2½- to 3-minute for the outlying portions during the busy period. Electric locomotives for the suburban freight service are proposed, as steam locomotives are wasteful of coal.

With steam operation, practically all suburban trains made the Flinders St. station a city terminal. But the service has now been improved by making through trips on electrified routes between outlying points, thus reducing the switching and delay in the city station. Such routes are from Williamstown east to Oakleigh and Glen Huntly, and from Sandringham north to Broad Meadows (Fig. 1).

Cost and Economy—The capital cost is put at about $30,000,000, with annual costs of $2,550,000 divided equally between operating expenses and interest. The cost has increased enormously beyond the original estimate of 1912 as a result of additions and enlargements of the original plans and also very largely due to the great increase in prices following the World War. Thus the turbo-generator equipment increased 100 per cent; electrical equipment for power house, substations and cars, 80 per cent; high tension cables, 78 per cent, and overhead wiring equipment 67 per cent. Labor costs also increased 70 per cent.

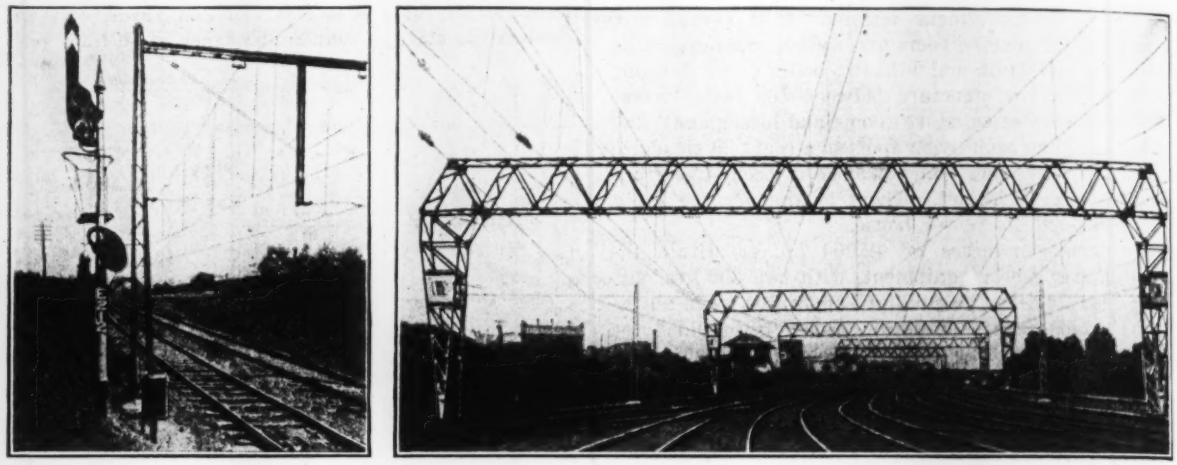


FIG. 3—BRIDGES FOR OVERHEAD WIRING ON MELBOURNE SUBURBAN LINES
At left, automatic signal and bridge for catenary cables on double track. At right, 120-ft. two-hinged arch trusses carrying catenary cables for group of tracks.

On the other hand, large operating economies have been secured. In 1921, the results of five lines operated by electricity indicated a saving of $230,000 in coal and $250,000 in staff and rolling stock, combined with an increased revenue of $955,000 due to better service. For that year, the power house required 54,000 tons of coal at $350,000, while an equivalent service by steam locomotives (but at lower speed) would have required 91,000 tons at $640,000.

This electrification was considered by the Victorian Railways Commissioners as early as 1898, and in 1908 a report was made by C. H. Merz, of London, who predicted that it would reduce operating expenses and increase traffic and revenue. Under an agreement made in 1912 the work has been planned and carried out by Merz & McLellan, consulting engineers, London, England, with E. P. Grove as their engineer in charge at Melbourne. British and Australian manufacturers supplied most of the material, but all electric equipment for the cars was furnished by the General Electric Co., New York.

Through the Reclamation Country

By F. E. Schmitt
Associate Editor, *Engineering News-Record*

A SERIES OF ARTICLES on Federal Land Reclamation is to start in *Engineering News-Record* in a few weeks. It will give a history of the twenty-one years of government irrigation, state the many problems of operation—engineering, agricultural and financial—analyze the various complaints that are being so emphasized by those who are seeking a reform of the current law and methods and seek to present some views as to a constructive policy in the future. Through it all will run the evident theme that irrigation, from planning, through construction to operation, is a continuing engineering problem.

As a part of the preparation of the series Mr. Schmitt is now traveling through the West, visiting irrigation projects, studying developments and interviewing builders, operators and settlers. He will write a series of letters of running comment on the situation as he sees it on the ground. These are not the final result of his trip but they will serve to acquaint our readers with the actualities of reclamation as revealed to an unprejudiced investigator.

This is the second letter. The first appeared in the issue of October 4.—*Editor.*

Grand Junction, Colo.

SEEN AT close range, a reclamation project in full-size operation is impressive. It is a community of many thousands of people grouped around and among the parts of a vast water-supply machine which spreads out over a hundred square miles or more. The machine must be operated: the required amount of water according to daily request or a fixed schedule of rotation must be admitted at each farmer's headgates, disputes between adjoining users about supply or overflow of water must be prevented, consumption must be measured, canals, gates and structures must be kept in order. Finally, hardest of all, payment for the water must be collected. The manager has a combined administrative, engineering and excise job of peculiar difficulty. He not only has to operate and maintain and repair his machine, but he must keep it in gear with the community. The successful manager with his water-masters and ditch-riders should know the family history of each one of his thousand or more farmers, how many cows he milks, what oil stocks he bought, whether he can pay his mortgage interest this fall, and why he is making a failure.

On the ideal reclamation project the job would be simpler—the manager would be an operating automaton with cash-register attachment. The ideal project is one on which every family is contented and happy and each farmer pays his debts, puts money in bank regularly and finally buys out his neighbor. But probably there is no such ideal project, just as there is no such community in the unirrigated world. Some men do not do as well as their neighbors; others become failures. There are quite a lot of failures on the reclamation projects (I have seen three projects so far) and the amazing part of it is that some of the failures now developing are men who have been there from the start. There are the skillful and the unskillful; the thrifty and the unthrifty. The latter kind doesn't manage to pay its debts and finds it impossible to meet the annual water charges and the installments of the construction charge which the nation advanced free of interest for twenty years. Largely the three projects are still in process of evolution though they are up to 14 or 15 years old; and the troubles incident to evolution are quite obviously at the root of most of the complaints and protests that are heard. There is still much pioneering to be seen, which answers an advance question. The rough work and hardship of starting to farm on irrigated desert is not all of the past. It appears that the period required to catch up with the game of making a living out of the allotted farm unit is not over after two or five or fifteen years, in a great many cases.

Scores of farmers are existing in the most primitive condition, scratching for a living, in debt and getting deeper in; and hundreds have left. Some never had anything, some have lost what they had at the start. This man quit, that one was foreclosed by creditors. There are a few abandoned farms, and it will take more pioneering to get them in operating shape. Plenty of prosperous farmers can be found, men who have not only made money but have built up thriving farms. But there are the others also. The settlers pioneered when they started, and needed a chance, a breathing spell to get going. Many still need a chance.

Making successful farmers out of pioneers is a many-sided problem. Numerous trouble-making factors are involved in converting raw irrigated land into a self-supporting farm community, and there are various opinions about them. But prominent among them are two facts which are early apparent, namely, that there is much poor land on the projects and many bad farmers. Some people say that "the bad farmer is found on the poor land." And a Federal Land Bank man whom I met said "that is where we get the majority of our loan applications." Nevertheless the two facts are separate. The poor land was there before the settlers came and the bad farmer was not made such by the land.

These facts are probably commonplaces to men in the irrigation states, but the man in the humid regions and particularly the non-farming citizen, who may have much to do with working out the future of reclamation, does not think of them as important factors. It may be that commonplaces of this kind make up the main part of the problem of operating reclamation successfully.

What To Do With Poor Land—First as to poor land. A reclamation project area includes both smooth and rough ground, flat and steep (or rolling) topography, good soil and poor soil; it may have areas of hard clay or troublesome zones of drifting sand. There are acres of ground that are practically non-arable. In some cases the settlers in a poor district were allotted larger areas than those in the good. But with this exception, all farmers on a project are on equal terms: they pay the same for water (annual charge for operation and maintenance) and they are expected to pay the same per-acre share of the original cost of the works (construction charge). Their taxes may be slightly lower because of lower valuation.

Most of the farmers on the poor land are just hanging on. It was poor land originally, and much of it should never have been included in the reclamation. This last was stated positively by an agricultural expert whom I met on one of the projects and was supported by other men of almost equal qualifications. On some projects much land has been injured by alkali or waterlogging (seepage) troubles not yet cured, but that

is not in question now; there is poor land today that was poor at the start, and it would have been well if engineers and soil experts working together had kept it out of the reclamation.

Why they did not seems to be a somewhat complicated question. The original reclamation law as interpreted by executive officials left the land open for homestead entry while the irrigation works were being built; the result was that on early projects good and poor land was taken up by settlers in the definite expectation of obtaining water, and it would not have been practicable later on to refuse to supply the men who had been unwise or unlucky enough to settle on poor land. Co-operation between soil experts and engineers did not go far enough, according to our present lights. Knowledge of soils was imperfect, and knowledge of irrigation agriculture was imperfect. The Department of Agriculture has maintained a dozen or so experiment stations on the projects for many years, and is still learning something about cultural and soil questions. In fact, successful irrigation farming seems to involve not only more labor and a different skill from that demanded by ordinary farming, but a somewhat different science, which is only partly worked out as yet.

Remedies—Unwise inclusion of poor land is chargeable to a number of agencies, among whom the engineer is bound to take his share of blame. However, the question today is not who was at fault, but what to do about the poor land—how to prevent continuing failures on it, with steady trouble and expense to the country at large, the local community and the settlers. Two lines of thought are being followed in this matter.

One involves classification of all land on a project into good, less good, etc., and adjustment of the terms of repayment accordingly. Such classification has been carried out on a few projects (notably on the North Platte), by varying methods, but apparently has not yet been put to use. The share of construction cost on the poor land could be lowered, but that on the good land cannot be raised because the farmer holds a contract which limits the amount he must repay. The time allowed for repayment might be varied, a longer period being fixed for poor land than for good; but the repayment period is laid down in the law by Congress, and at present is alike for all. On future projects it would seem quite possible to grade the construction charge according to land quality. On the existing projects—those which because of poor land are not doing as well as they should—it may be necessary for Congress to authorize extensive readjustments of burdens according to land quality.

The worst of the land ought to be abandoned—this again in the judgment of agricultural men who have watched the farmers' results. Where land is so rough that proper leveling is unduly costly for the settler, so that he is likely to use inefficient irrigation methods or be seriously hampered in getting under way, the advisability of doing some leveling at government cost suggests itself; but on this last subject decided differences of opinion exist.

Paternalistic Suggestions—The other way proposed for dealing with poor land is based on developing the right farming methods for such land (readjusting the size of the farms to suit, where necessary) and teaching these methods to the farmers, with the help of some means of insisting that they adopt them—if such means can be found. This is also a method proposed for dealing with the bad farmer, namely, to make him into a good farmer rather than let him go to the dogs. In either light, such an instructing and assisting process would require a large organization and a strongly administered agricultural purpose on the part of the government, neither of which exists. The Reclamation Bureau is not an agricultural organization and is said to have no authority to use the reclamation fund for such work, while the Department of Agriculture appears to have no recognized responsibility for the success of the reclamation projects, besides having no funds. On the other hand, the states in which the projects are located seem to find plenty of troubles of their own without bothering much about nursing the irrigation communities; that is Uncle Sam's business! County agents and state experiment and demonstration work help a little, but they do not go far toward reaching the incompetent farmer.

With reference to the bad farmer: while some people want him to be advised and helped, others would eliminate him just as early as possible. They claim that unskilled farmers—ex-school-teachers, bookkeepers or dentists—have no more business on a reclamation project, where the nation has invested much money, than a farmer has in dentistry or teaching. They want to select the men who go on the projects and accept as settlers only able, strong, experienced farmers with ample money and credit.

The underlying idea of such selection of course would deny the right of trying to found a farm home in the West to all except those few who could meet certain tests or inquiries. People who are not ready to admit that selection in advance is feasible or desirable say that there should be automatic selection, by practical trial; let the fittest survive! Those farmers that fail to make a success, fall behind on water and construction payments and are short of credit at the bank, should be closed out and the successful farmers alone be retained—with special treatment for the occasional farmer whose bad luck is not his fault. Stated this way, the process seems a little cold-bloodedly business-like, particularly if the unsuccessful farmer has been handicapped by poor land. But it is the method which is necessarily applied on all private irrigation projects and which operated in all the farm pioneering that has gone on from the earliest days; and it is the method of every other business and occupation besides.

Reorganization of Alsace-Lorraine Railways

One of the more difficult of the problems of adjustment which the French Parliament is called on to solve as the result of the re-incorporation of Alsace-Lorraine into French territory is the relation of the Alsace-Lorraine railroads to the French railroad legislation. The possibility of operating the Alsace-Lorraine railroads directly by the state was at one time considered, but rejected. By a plan now advocated the Alsace-Lorraine railroads will be operated by the Compagnie de l'Est, but upon a special account and under the direction of an office located at Strasbourg. The proposed plan also provides that the three Departments of the restored provinces shall be represented on the Railroad Council (Conseil des Chemins de Fer). Employees will retain all rights which they have earned and the special features of the railroad operations, such as fourth-class tickets, Sunday tickets, etc., will be conserved.

New Logarithmic Equation for Friction Losses in Pipes

By F. W. Greve
Associate Professor of Hydraulic Engineering, Purdue University, Lafayette, Ind.

Among the large number of formulas available for the determination of friction losses in pipes, those of the exponential type possess the greatest advantage. All of them, no matter what the type may be, depend upon coefficients which vary with the diameter and length of pipe, velocity of flow, etc. The formula herein described has been devised with the aim of reducing the number of variables to a minimum. The basic equation for its derivation is,

$$h_f = A(v)^B \qquad (1)$$

where h_f is the friction head, or the head lost due to friction in 1,000 ft. of iron pipe, A is a coefficient dependent upon the diameter of the pipe, and B is a constant exponent for all diameters. The coefficient A may be expressed in terms of two other constants, E and F, thus enabling computations to be made without reference to book or tables.

The formula (1) is empirically derived from the plotting of the logarithm of the friction head against the logarithm of the velocity on rectilinear cross-section paper, or, better yet, the derivation of the ratio of these two quantities when plotted on logarithmic paper. The graph is a straight line when plotted on logarithmic paper, and since its position is determined by three points it is only necessary to plot the minimum number of values of friction head and velocity. An easy mathematical solution for this latter graph is by the centroid method. The centroid of all the plotted points is first obtained by finding the mean values of friction head and velocity. The points on either side of this centroid are then treated in a like manner to locate their respective centroids, thus determining three points that establish the straight-line graph. A graphical check is readily applied by measuring the slope B, with the velocities plotted as the abscissas, and ascertaining the value of the coefficient A, which is the value of the friction head for a velocity of 1 ft. per second.

VARIATION OF THE COEFFICIENT, A, WITH THE DIAMETER, d

d, in.	1.0	1.25	1.5	2.0	2.5	3.0
A	10.4	7.49	6.22	4.86	3.76	3.03
d, in.	4.	5.	6.	8.	10.	12.
A	2.15	1.70	1.34	0.960	0.757	0.597
d, in.	16	20	24	30	36	42
A	0.429	0.330	0.267	0.204	0.166	0.140
d, in.	48	54	60	66	72	.....
A	0.119	0.104	0.0917	0.0819	0.0744	.....

The values of the various constants noted in this article are based to a large extent on Williams and Hazen's "Hydraulic Tables," and have to do with iron pipes that have been in use for moderate periods of time.

The values of A and B listed in the accompanying table were first obtained as previously outlined. The exponent B is a constant and equal to 1.85 for all sizes of pipe under consideration. The accuracy obtained with a fixed value of B is well within practical limits, for no two pieces of pipe, even when new, show exactly the same friction head for a given velocity.

The formula, $h_f = A(v)^B$, is simple and easily manipulated with the aid of the accompanying table, which shows the variation of A with the nominal diameter in inches. With the idea of eliminating the variable coefficient, A, from the equation, the values of A were plotted vertically against the diameter, d, on logarithmic paper, the graph resulting therefrom being a straight line of the form,

$$A = E(d)^F \qquad (2)$$

where E is a constant coefficient; d is the nominal diameter of the pipe in inches; and F is the tangent of the angle that the graph makes with the d axis. The value of F is negative, showing that the graph extends from the upper left towards the lower right of the diagram; or that the value of A decreases with increase of d. Combining equations 1 and 2, there will result,

$$h_f = E(d)^F(v)^B = 10.96(d)^{-1.169}(v)^{1.85} \qquad (3)$$

$$\text{Log } h_f = 1.03995 - 1.169 \log d + 1.85 \log v \qquad (4)$$

Thus for any iron pipe, the friction head per 1,000 ft. of length can be expressed in terms of one variable, namely the velocity. Besides the advantage of simplicity and ready adaptation to accurate plotting, the exponential equation cited above eliminates the necessity of resorting to the cut and try method of solution, as exemplified in the commonly used formula,

$$h_f = \frac{fL(v)^2}{2gd}$$

where the velocity or the discharge is to be calculated.

German Labor in French Building Trades

Paris Correspondence

A FACT generally recognized is the shortage of many kinds of labor in France, in mines, in railway construction, in agriculture, notably in masonry and in the building trades in general.

An interesting experiment has been made during the past eighteen months or so in the Liberated Regions of North France by the employment in the building trades of German labor under conditions which if they do not bespeak a wholly liberal interpretation of the relations of the employer and the employee have at least produced interesting results on both sides.

In the region of Montdidier the Société Parisienne d'Enterprises has employed eighty German workmen recruited through the labor bureau of Treves, but only after serious investigations as to the sentiments, honesty and capacity of the workers in question. Of this number thirty were ultimately rejected as undesirable and the fifty remaining, divided into two groups, have been employed on construction and building jobs at the trades of masons, plasterers and tile workers. Invariably they have produced satisfactory results, as well from their deportment in a lately invaded country and for the quantity and the quality of the work they have turned out. Their pay has ranged from 35 to 40 francs a day (at normal dollar exchange, $7 to $8) of which 10 francs is paid the contractor for their food and lodging.

An impartial estimate of the worth of this labor, which was recruited from the Rhineland provinces, was made by the consulting architects and it was considered that it produced results which were technically excellent and rapid. Their relations with the neighboring populations were invariably correct, no complaints having been made at any time. They worked chiefly under orders which were passed to them by a Swiss engineer trained in the construction trades and speaking French and German. In summing up it is the opinion of the French government labor bureau that the experience had given most satisfying results.

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Designing Steel Details With Attention to Drainage

By Arthur M. Shaw
Consulting Engineer, New Orleans

WHILE it is generally recognized that structural steel, exposed to moisture and atmospheric action, is susceptible to rapid corrosion, an examination of many bridges and other steel structures would convince an observer that it is still pertinent occasionally to suggest that more attention be given to the design of details in order that complete drainage may be effected, if this be possible. The accompanying photograph (Fig. 1) well illustrates the result of failure to provide such drainage.

FIG. 1—STEEL CORRODED BY LACK OF DRAINAGE

The steel members shown consist of two 3-in. standard angles placed as corner protections to the concrete slot for receiving sliding canal gates at the end of a flume. Shortly after the flume was placed in operation (about eight years ago), the system of control was changed and the gates were discarded, thus making it unnecessary to afford any protection to the angles shown.

It will be noted that the photograph shows that one of the angles appears to be in good condition while the angle at the opposite side of the opening has lost practically its entire effective section by corrosion. The 6-in. scale lying across the opening will give an idea of proportions. The sketch (Fig. 2) shows these angles in section as "Angle A" and "Angle B," respectively. It is shown that each of these angles is tipped slightly from the vertical, to conform to the inclined position of the sliding gates, angle *A* being in such a position that it drains readily, while the back edge of angle *B* is depressed about ¾ in. below the level of the concrete work, forming a water trap from which no outlet was provided. Not only was the top leg of angle *B* destroyed for a considerable portion of its length but the vertical leg was so corroded as to retain no material structural strength.

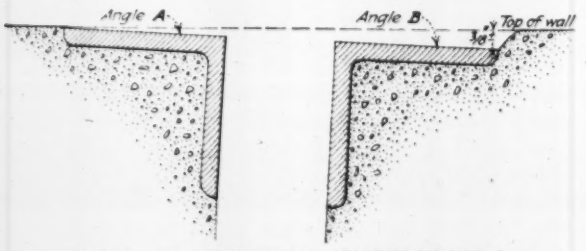


FIG. 2—ANGLE SECTIONS SHOWN IN FIG. 1

In the structure shown, there were three pairs of angles, all similarly placed. In no case did the drained angles show any material reduction in section and in no case did the undrained angles fail to show a sufficient reduction in section as to render them unfit for any useful purpose, though the central section (shown in the photograph) was the most extreme example of destruction.

How One State Aids Contractors in Locating Road Materials

By G. H. Henderson
Office Engineer, State Board of Public Roads, Providence, R. I.

IN ADDITION to the standard plans and specifications at the disposal of prospective road bidders, it is the practice in Rhode Island to furnish the contractors with all the information at our disposal concerning the availability of local materials, such as sand, gravel and stone purposed to be used in the proposed construction.

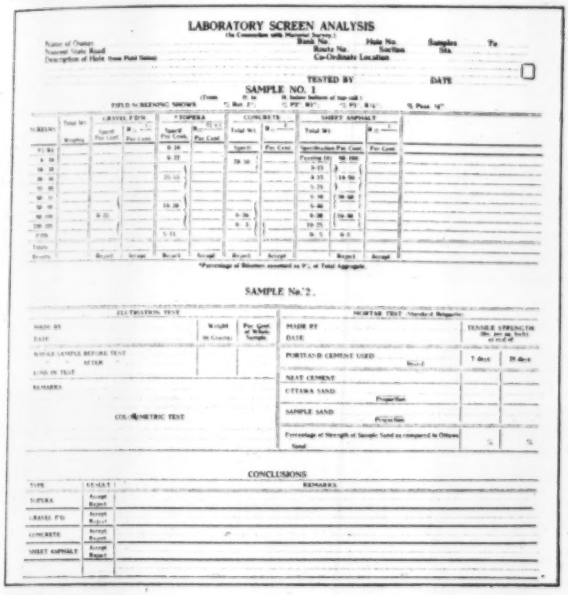
On the quantity sheet of the standard plans, as is customary, are given summaries of the cuts and fills between stations, the locations and quantities of foundations, pipes, catch basins, guard rail, masonry etc. The quantity appearing in the proposal form opposite each item agrees approximately with the quantity appearing upon the quantity sheet of the plans.

The purpose of the material survey is not to render unnecessary personal search by the contractor for suitable material for the job, but to aid him in his search. It calls to his attention certain sources within reasonable distance of the job where materials passing specifications may be obtained, and the approximate quantity available. It saves him unnecessary investigation of certain gravel banks or sand pits which are known from tests to be of inferior quality, or which fail to pass the specifications in other respects. Further information is given such as owner's names, their willingness to sell, length and character of haul and water facilities. There is no guarantee on the part of the state that the banks will run true throughout as per the samples taken and tested. The state does not own any banks nor is there any law which permits it to purchase.

The information for the material survey is obtained by a material survey force working under direction of our testing engineer, who also has charge of our testing laboratory. The force consists of a nucleus of two men regularly employed in this work and is augmented from time to time by men from other departments of our work. Material survey work is practically continuous and will be until the whole state has been covered. It is our policy to use men in this work who are temporarily out of employment in their regular capacity. Resident engineers and assistants at the completion of a contract and until construction work resumes, either join the material survey force or are used to augment

the field surveying parties or the office force, according to the experience and ability of the men.

A material survey for a contemplated contract consists in the locating and testing of all known sources of supply of mineral aggregate within reasonable distance of the job which is purposed to be used in the work. The final selection of the type of pavement or foundation often depends upon the data obtained from the survey. In the case of gravel or sand banks sufficient test holes are dug over the area of the bank to insure representative samples. The average depth of the test holes over the top area of the bank is 6 or 7 ft., while if there is a working face, by stepping down, greater depths are obtained. Fifty-pound samples are taken and run through the 2-, 1- and ½-in. screens in the


LABORATORY SCREEN ANALYSIS

SAMPLE NO. 1

SAMPLE No. 2.

CONCLUSIONS

DATA GIVEN CONTRACTORS IN SCREEN ANALYSIS

field. The aggregate passing the ½-in. screen is sent to our laboratory and there run through the colorimetric, elutriation and screen analysis tests. The screens used in the laboratory screen analysis cover the specifications for sheet asphalt, Topeka, concrete and gravel foundation. The aggregate in the bank from 2 in. up to one and two-man size rocks is determined in the field and stated in terms of percentage.

The knowledge obtained and conclusions drawn from the tests as to the possibilities of a bank are passed on to the contractors interested in the contract. It is issued in pamphlet form under the caption "Material Survey," and is accompanied by a sketch map covering the vicinity in which the contract is located. On this map, which is drawn to scale, the location of roads is shown and the portion included in the contract marked for contrast. The gravel and sand banks are shown in their relative location and are marked with numbers corresponding to those listed in the pamphlet.

For the benefit of the contractor in the field, station signs are posted at every 1,000 ft. along the job, and also direction signs and arrows leading to each bank or pit. The bank numbers are painted on the signs so that the contractor has little difficulty in finding a particular bank after seeing its relative location on the map.

Part of a page from the material survey pamphlet furnished the contractors for a job now under contract is shown herewith. For the sketch map accompanying the pamphlet we photograph the portion of the Standard U. S. Topographical Sheet covering the area desired after properly noting and marking the sheet. Photostat copies are then available in any number desired. The record sheet used by the material survey force in the field is undergoing a change at the printers and is not given, but a specimen laboratory screen analysis record sheet is shown.

MATERIAL SURVEY

Contract No. 2304 Federal Aid Project No. 17
State Road—Louisquisset Pike
From Marieville 3.13 miles northerly.
Type of Pavement—Reinforced Concrete. Length 3.13 miles.
Local Materials Required:
Gravel for Gravel Foundation.....4500 cu. yd. approx.
Sand for Concrete Pavement.....3800 " " "
Coarse Aggregate for Concrete Pavement .....5600 " " "

Sand and Gravel tests by R.I.S.B.P.R. testing laboratory.
Stone Tests by Pittsburgh Testing Laboratory.

GENERAL DESCRIPTION OF AREA

Circles on the accompanying map show the location of local gravel banks and rock quarries found after a careful survey of the territory within a reasonable distance of this contract. All banks have been marked in the field as well as road stations given on nearest telegraph poles (every 1,000 ft. of contract length). In most cases pits have been left open for inspection at each bank noted.

Only one gravel bank passed the specification for gravel foundation, requiring 40 per cent to pass 1 in. size. Others passed smaller sizes required. Most of the banks passed the requirements for sand for cement concrete pavement with the exception of Bank No. 19 and No. 23.

Stone is abundant and generally of good quality. Very few stone walls are available. Ledges encountered in Section II will yield most of stone required (estimated at 4,000 cu.yd.). Tests show that this ledge stone passes quality specifications for concrete coarse aggregate. Gravel Bank No. 22 with 40 per cent to 70 per cent of gravel over ½ in. up to one-man size should furnish large amount of stone. This stone passes quality requirements.

Data on Gravel Banks

Bank No. 19.
Owner—W. E. Nicholds—does not care to sell.
Location—Station 2,600 approx. Left Sec. II.
Accessibility—0.5 mi. west of State Rd. over gravel road—easy grades—weak bridge 8 ft. span.
Description—Large bank, 13-ft. face with considerable clay in evidence. Limited in amount by owner to approximately 2,000 cu.yd. of material.
Conclusions—Samples of material did not pass gravel foundation or cement concrete spec.

Bank No. 21.
Owner—Paul Cimini—will sell.
Location—Station 800 approx. Left Sec. III.
Accessibility—1,000 ft. west of State Rd. on gravel road with slight upgrade to job.
Description—2,000 to 3,000 cu.yd. available in 6-ft. to 9-ft. face under 12 in. to 14 in. loam.
Ledge outcrops at various points in bank.
Conclusions—For gravel foundation (only 28 per cent over 1 in. size, with 40 per cent called for) but passes specifications on smaller sizes.
For cement concrete—sand and gravel passed all requirements.

Bank No. 22.
Owner—Mrs. Jane Bradley—will sell (consult boss farmer at Fair Oaks Farm).

Location—Station 250 approx. Left Sec. IV.
Accessibility—0.7 mi. west of State Road on narrow gravel road, easy grades.
Description—Large bank, approx. 10,000 cu.yd., containing large quantity of heavy gravel. Six-foot to 9-ft. face under 12 to 18 in. loam. Coarse aggregate 40 per cent to 80 per cent over ¼ in. up to one-man size.
Conclusions—Samples of sand and stone passed all requirements for gravel foundations, and cement concrete specifications.

Steam Shovel Places Heavy Water Pipe

IN THE construction of a dam for the Tipton Water Co. in the mountains near Tipton, Pa., the contractor had to place a line of 36-in. cast-iron pipe and also one of 24-in. pipe. The method used is shown in the illustration. The pipe was brought in on the narrow-gage railroad at the left. Lengths were picked up by the shovel and swung to place. The shovel moved ahead as each length of pipe was set so as to be in position to place the next length. A considerable saving of time and labor was gained. A. L. Anderson & Brothers, Inc., of Altoona, Pa., is the contractor with A. F. Ponesmith superintendent in charge of the work.

Low-Water Bridge Built in Kansas

BY CHARLES O. BOYNTON
County Engineer, Gove County, Kansas

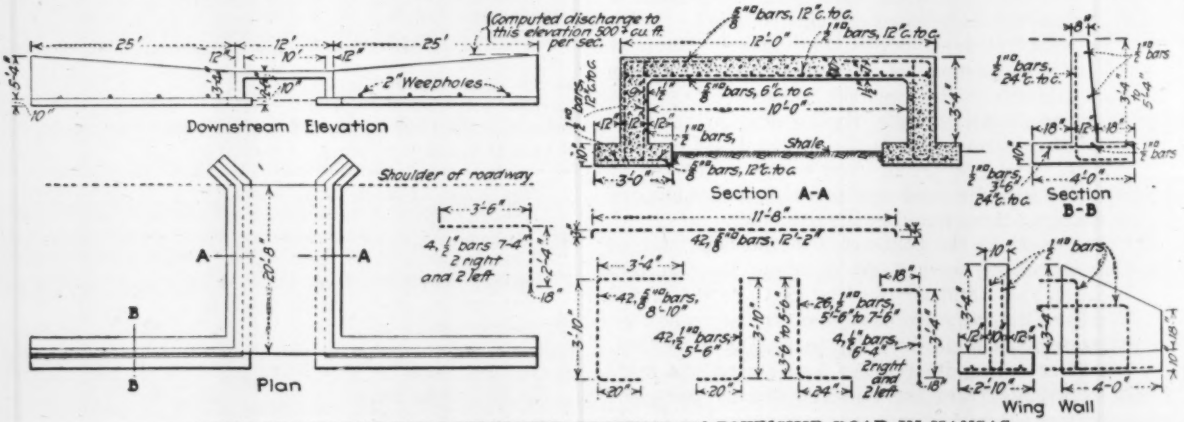
IN PARTS of western Kansas, in common with many other similar localities, where grazing land predominates and where the rainfall is insufficient for general farming, the funds available for roads and bridges are very limited. The Kansas law limits the mileage of county roads in the western part of the state to about 150 miles, the minor roads being designated as township roads and maintained by the township officials. The funds available for the county roads amount to a little more than $100 per mile for construction and maintenance and from this money must also be built culverts and bridges on township roads where the span is in excess of 5 ft.

Except during seasons of unusually heavy rainfall, the streams are generally dry. Then, when it does rain heavily, the rise is sudden but the crest soon subsides. This characteristic, coupled with the light traffic and insufficient funds, has caused the "low-water" crossing to be much used in preference to the ordinary bridge. The low-water crossing is designated so that the opening below the floor is sufficient to pass the ordinary low water flow while the high-water level may be considerably above the floor level. The short interruptions to the light traffic at times of occasional floods do not justify the additional expense of regular bridges.

The accompanying drawing shows a low-water crossing recently completed by Gove County. It is estimated that the ordinary high-water discharge will seldom exceed 500 cu.ft. per second, although occasional floods will greatly exceed this amount. The flood peak in excess of the 500 sec.-ft. would last but a very short time, a few hours only, and probably do but little damage to the approaches. The 10-ft. opening is ample for the ordinary low-water flow. Walls extending out from the culvert 25 ft. in each direction along the downstream side of the roadway fill act as dams or retaining walls to hold the fill. They are set into the bedded shale. Their top rises gradually from the floor level 2 ft. to their ends, thus forming a notched spillway 62 ft. in length. A short apron is provided, but the water cushion at times of flood is relied upon to prevent undercutting. The gravel roadway is not expected to scour.

This structure contained 30 cu.yd. of reinforced concrete and was built by force account for $575, including the excavation but not including the filling or the overhead expense. A reinforced-concrete high-water bridge would have cost about twice as much. This crossing was built on one of the township roads and replaces a culvert having sidewalls supporting a wood floor, the approaches to which have washed away several times.

The new structure was designed and built by Charles O. Boynton as county engineer.



LOW-COST BRIDGE FOR LOW-WATER CROSSING ON TOWNSHIP ROAD IN KANSAS

From Job and Office

Hints that Cut Cost and Time

From Job and Office

For Contractor and Engineer

Irregular Areas in Yardage Problems Solved by Geometry

By J. R. Jahn

Irrigation Engineer, Berkeley, Calif.

To compute yardage in canal or levee work the following method can be used to advantage. For single computations a pair of triangles and a pencil will give the solution in the time usually taken to check the planimeter or figure out the area constant for the scales used.

It is convenient to plot the cross-section on profile paper and any convenient scales for the horizontal or vertical distances can be used. If plate "A" paper is used these scales are ½ in. horizontal = 5 ft., and ½ in. vertical = 1 ft. In their proper positions draw the subgrade and sides or banks. The inclosed polygon will then represent the area in the cross-section of the cut or the fill at the given station. The volume may be found by the pyramidal formula or by simple multiplication, if the area of cross-section be known.

Fig. 1 gives the "key" to the solution: the base of the cut being given zero width for simplicity in this case. *a*, *b* and *c* are points on the ground surface and the area (*abc*) is desired.

Produce *oa;* draw a_1b parallel to *ac;* connect a_1 and *c*. The triangle (aa_1c) has been substituted for the triangle (*abc*) and has an equal area since the base *ac* and the altitude of the triangles are the same. Since oaa_1 is a straight line, the triangle (oa_1c) has the same area as the polygon (*oabc*). If now, *y* be the intersection of the ordinate or vertical from *o* with the line a_1c, the distance *oy* can be read on the profile scale. Likewise the horizontal distance a_xc_x may be found.

The area oa_1c is then ½(*oy*) (a_xc_x). (See triangles oya_1 and *oyc*.)

In Fig. 2, *cd* is the base of the proposed cut and *da* and *cb* are the banks or sides, the slopes conforming to the distorted scales used. In addition to the transformation of the cross-section of the ground surface into a straight line, the triangle (oa_1b) is substituted for the trapezium (a_1bcd) by drawing a line through *d* parallel to a_1c to intersect *bc* produced. The area is again ½ (*oy*) × (a_xb_x).

Fig. 3 shows the method applied to levee estimates. As many sides *abc* . . . . as desired can be used. The problem then consists of substituting single lines for pairs until the polygon is reduced to a triangle.

I have found this method very useful in getting a quick check on the approximate area of parcels of land, mapped to scale and the accuracy is often surprising. A little ingenuity is required in order to keep the figure within the bounds of the drawing. The area of the resulting triangle is found by multiplying the scaled base and altitude and taking one half the product.

Houses Barged Across Kanawha River

TO MAKE room for the new state capitol at Charleston, W. Va., a whole community, comprising 32 houses, was barged across the Kanawha River by John Eichleay, Jr., Co., of Pittsburgh. The houses were set upon blocking 40 ft. above barge floors.

Drainage Across Side Roads

In carrying drainage of a road side ditch across intersecting roads ordinary practice in placing culverts is to install them on the line of the side ditch of the main road. One disadvantage of this practice is that the width of the side road often determines the length of culverts to be used. If this culvert, which is the exact width of the intersecting road, be laid as indicated above, it necessitates too sharp a turn from the side road into the main road or vice versa. Charles O. Boynton, county engineer at Gove, Kan., has established a practice of placing the culvert across the side road back from the side ditch line of the main road about 15 ft., thereby permitting an entrance curve from the side road to the main road and affording a much better turn.

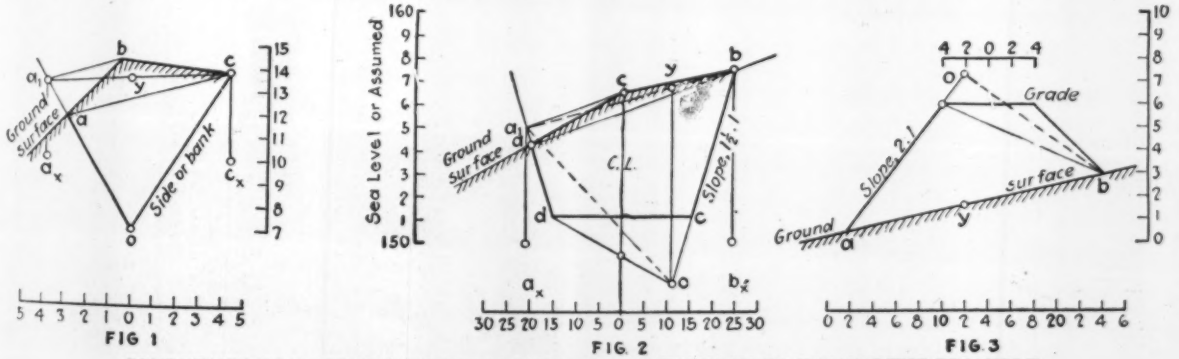


FIG 1 FIG 2 FIG 3

COMPUTATION OF AREAS BY METHOD OF REDUCING POLYGON TO EQUIVALENT TRIANGLE

Concrete Shed Protects Railroad Track from Mud Slides

ALONG the upper reaches of the Sacramento River in California the Southern Pacific R.R. traverses a canyon in which mud slides have been troublesome. The slides were so frequent at the point where the track enters the east end of Tunnel 9 that a reinforced-concrete shed was built somewhat similar to a timber snowshed, but strong enough to carry a load of mud and

"MUD SHED" PROTECTING PORTAL OF TUNNEL

rock. The outer wall, as shown in the accompanying picture, has openings which aid in ventilation and avoid entirely closing off the passenger's view.

Formula for Parabolic Railway Curves

BY L. PIÉRARD
Draftsman, Canadian Pacific Ry., Winnipeg

FOR computing the length of vertical parabolic curves and the largest offset midway between the ends, railroad engineers in Canada are using a formula briefly stated as follows:

Having selected the rate of change (usually 0.05 for sags and 0.10 for summits, in railroad work), the length of the curve in stations (100 ft.) is found by dividing the algebraic difference in grades by the rate of change. This gives the B.C. and E.C., the P.I. of tangents to a parabola being equidistant from the points of tangency. The offsets equal one-half the rate of change multiplied by the square of the distance (in stations) between point of offset and point of curve.

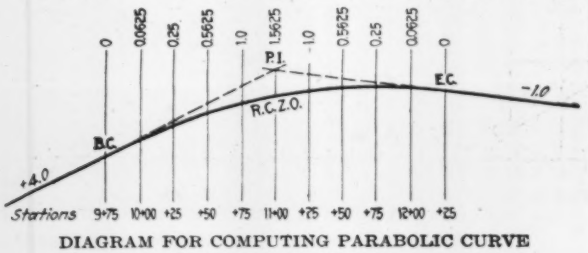


DIAGRAM FOR COMPUTING PARABOLIC CURVE

Referring to the formula for vertical curves suggested by Stanley J. Nichols in *Engineering News-Record*, Sept. 13, p. 443, using the grades given in that example and the rate of change as 2.0, we would then have the following:

P.I. is at Sta. 11 + 00

$$\text{Length of curve} = \frac{4 - (-1)}{2}$$

$$= 2.5 \text{ Sta.} = 250 \text{ ft.} \begin{cases} \text{B.C. at Sta. } 9 + 75 \\ \text{E.C. at Sta. } 12 + 25 \end{cases}$$

$$\text{First offset at Sta. } 10 = \frac{2}{2} \times \left(\frac{25^2}{100}\right) = 1 \times \left(\frac{1}{4}\right)^2 = 0.0625$$

$$\text{Second offset} = 0.0625 \times 2^{-2} = 0.25$$
$$\text{Third offset} = 0.0625 \times 3^{-2} = 0.5625$$
$$\text{Fourth offset} = 0.0625 \times 4^{-2} = 1.0$$
$$\text{Fifth offset} = 0.0625 \times 5^{-2} = 1.5625$$

Offsets taken from E.C. as starting point will have the same values as those taken from B.C.

From Job and Office

Hints that Cut Cost and Time

Jet Aids in Sluicing Material Delivered to Fill on Pier

THE INNER deck floors of the transit sheds in the Ballantyne Pier at Vancouver, B. C., are supported on a gravel fill retained on one side by concrete sheet-piling and on the other side by a retaining wall. Gravel for the fill was brought to the job on barges and some study was given to the question of the cheapest method of lifting the material from the barges and

SLUICING GRAVEL DOWN A FLUME INTO FILL

From Job and Office

For Contractor and Engineer

delivering it to the fill across the 100-ft. width of pier already decked over.

An aid in finding an easy method was the 10-in. water main down the center of the pier that was used to operate the water jets in sinking cylinders through hard material, and from which some water could be spared without overtaxing the pumps. At the outer side of the pier a hopper was erected and from it a flume was built to the area to be filled, 100 to 150 ft. distant. The gravel was clammed from the barge into the hopper by means of a floating derrick and a 3-in. pipe discharged continuously at the bottom of the hopper, the jet being directed down the flume. This arrangement was described in *Engineering News-Record*, Sept. 13, 1923, p. 440. Some 5,000 cu.yd. was placed by this method, which was developed by the Northern Construction Co. of Vancouver, of which William Smaill is chief engineer.

Street Widened by Moving Concrete Curb and Gutter Sections

By J. D. Adams
Secretary, Engineers Club of Sioux City

PUT to an enormous expense of widening over sixteen blocks of streets to care for the increasing traffic, City Engineer L. J. Hintgen of Sioux City, Iowa, devised every possible means of saving money. One of the stunts was the setting back of a curb and gutter unit. When the curb and gutter were placed several years ago the expansion joints were made entirely through the concrete, making each section a distinct unit. A force of men with crowbars succeeded in moving the sections very rapidly.

The work was done on a contract at 34 cents a foot. The bid on new curb without the gutter was 58 cents. Thus a saving of 24 cents a foot besides a 2-ft. strip of gutter was made. There were only 600 ft. of this kind of gutter, the balance being concrete curb alone, or stones. The stone curb was moved for 29 cents a foot.

Flangeways Kept Clear of Asphalt—In paving the Ballantyne Pier at Vancouver, B. C., flangeways or grooves were left along the rails of the railroad tracks in the usual manner when placing the concrete. When the top dressing of asphalt was put on, however, a wooden filler was put in these grooves extending up to and covering the top of the rail. The upper surface of the filler strips was made to conform to the grade to which the asphalt was to be finished. Using this method, the black top material was dumped, spread and rolled freely without concern about the grooves. The work was therefore finished more quickly than if care had to be used to keep the flangeways clear. After the material had cooled, the wood strips were removed from the grooves and both track and pavings were ready for immediate service.

Tanks Are Built Roof First—A novel method of erection which permitted all assembling and riveting to be done on the ground was employed in building four oil storage tanks 83 ft. in diameter and 33 ft. high for the Union Petroleum Co., Belgium. The top ring was erected first, resting on supports and jacks at the ground level, the jacks being inside the tank. Then the arched ribs for the roof were placed and roof plating riveted on. Then this completed section was raised by jacks to permit the placing of the second ring, the first ring being supported on blocking and the jacks then released. There were thirty-two 5-ton jacks with lifting racks 63 in. high, the ring plates resting on the claws at the bottom of the racks and being held from slipping by vertical pins set in holes in the claws. After the last raise the lowest ring was riveted to the shell and the bottom. In raising, the foreman stood in the center of the tank and at his command the man at each jack gave a turn to the crank handle. This method is described briefly in the "*Water Tower*" by Jules Mahy, managing director of Mahy Frères, Ghent, Belgium.

Derrick Made of Standpipe Roof Trusses—In the erection of two 2,000,000-gal. standpipes 60 ft. in diameter and 100 ft. high, at Dallas Texas, construction methods were complicated by the necessity of providing a derrick high and heavy enough to place the steel plates forming the standpipe, as the usual methods of erection could not be employed. In a recent issue of *Water Tower*, published by the Chicago Bridge & Iron Works, is explained the method whereby trusses forming the conical roofs of the tanks were so detailed as to form a full-circle derrick. Sixteen of the 24 trusses forming the roof were used in assembling the mast, which was approximately 130 ft. high and 8 ft. square. The boom, 35 ft. long, was made of two trusses. There being 24 trusses to each standpipe, the derrick was located out of center so that the six remaining trusses could be raised and placed in final position before dismantling the derrick. The plates in the lower sections of the standpipe weighed 5 tons and those in the upper courses 1 ton, though the sections were each of the same size: about 7 ft. wide and 24 ft. long.

MOVING CURB AND GUTTER SECTIONS TO ALLOW FOR STREET WIDENING IN SIOUX CITY

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Grant Smith: An Appreciation

Sir—In reading over your description of work done by Grant Smith (*Engineering News-Record*, Oct. 4, p. 571) I realize how impossible it is to indicate the scope of work handled by him, or to indicate his position in the construction industry. He always avoided publicity, moved so quietly, and thought into the future to such a degree that comparatively few knew he was the head of the organization which built Shoshone Dam, removed 7,000,000 cu.yd. of earth by sluicing Denny Hill, Seattle, into the bay, and handled the removal of some 26,000,000 tons of earth in one contract for the Department of Natural Resources of the Canadian Pacific Ry. In the most active period of this latter mentioned work, which was also the most active period of the Panama Canal construction, more yardage was moved month by month in this location on the Canadian prairie than was moved in the Canal Zone.

It is probable that if statistics were prepared, it would be found Mr. Smith headed organizations which had actually constructed more miles of tunnel, more miles of railroad and moved more yards of earth, than any other person in this country.

Silent, industrious, honorable, he believed that publicity added nothing to man's achievement. He sought to carry out all his contracts according to the original intent of the agreement so completely, and his dealings with all men were so honorable, that he had a following of associates, employees and sub-contractors comparable with none in our construction history.

M. J. WHITSON,
New York, Oct. 8. Stone & Webster, Inc.

G. W. Fuller at the London Institution of Sanitary Engineers

Sir—No name is better known among water and sanitary engineers in England than that of George W. Fuller. His work is almost as well known in England as in America. It was therefore very gratifying to sanitary engineers here to know that Mr. Fuller was coming to England with the intention of reading a paper, and with the idea of improving the very friendly relations which already exist between the engineers of the two countries.

Isadore Mendelsohn, corresponding secretary of the Conference of State Sanitary Engineers, Washington, D. C., recently asked for information on the object and work of the Institution of Sanitary Engineers. His letter was sent to me, as president, and I suggested that if an American engineer would read a paper in London before the Institution, the result could not fail to be advantageous. It is further to be noted that in my presidential address of last January I drew attention to the advantage of the special consideration of methods of sanitation and drainage, having regard to American practice. There was an immediate response to this suggestion. It was expected that Prof. George C. Whipple of Harvard University would write a paper, to be presented by Mr. Fuller on a visit to London. Later on it was decided that Mr. Fuller would present a paper of his own. This resulted in a most interesting review of American Sanitary Engineering Practice, read by Mr. Fuller before a representative meeting of the Institution of Sanitary Engineers, held at the International Shipping, Engineering and Machinery Exhibition at Olympia on Sept. 10. Preceding this meeting a number of representative engineers received Mr. Fuller at lunch, among them being E. A. Sandford Fawcett and Dr. H. T. Calvert, respectively chief engineer and chief chemist of the Ministry of Health; Prof. E. R. Matthews of the Office of Works; Prof. Henry Adams, Dr. Hele Shaw, A. J. Martin, Henry C. Adams and G. M. C. Taylor, the latter representing his father, Midgeley Taylor. Letters were received from a great many other engineers who were unable to attend, including J. D. Watson of Birmingham, H. E. Stilgoe, chief engineer of the Metropolitan Water Board, and W. J. E. Binnie.

It is certainly very desirable that the connection between engineers on both sides of the Atlantic should be strengthened. It is understood that an International Convention of Sanitary Engineers will be held at the British Empire Exhibition, which is to be opened next year at Wembley. This will be one of the largest and most important exhibitions held in the country It is to be hoped that American engineers and scientific workers will contribute papers upon suitable subjects to be read at the convention.

London, England, Sept. 11. H. C. H. SHENTON,
President, Institution of Sanitary Engineers.

Reference Books for Japanese Engineers

Sir—Referring to the letter published in *Engineering News-Record*, Sept. 6, 1923, p. 401, from Dr. J. A. L. Waddell, containing an appeal to American engineers for financial aid to Japanese engineers, there still exists an opportunity for us to give expression of our feeling of interest and sympathy for the engineers of Japan who have suffered so severly through earthquake, flood and fire. It is suggested that, in addition to any contributions which may be made for immediate and emergency relief, through established agencies, the engineers of this country might undertake to establish a memorial library or section of a library, which would be distinctly a contribution from the engineers of America to the engineers of Japan, this library to be made up of the latest editions of representative reference books on engineering subjects. It might also include, if procurable, bound volumes of leading technical journals. Most Japanese engineers read English and it is believed that such a library would be of substantial benefit.

If the above idea appears practicable, it is suggested that there probably is no American engineer having so wide an acquaintance with engineers of Japan, or an acquaintance extending over so long a period of years, as Dr. Waddell and that he might be prevailed upon to make inquiry as to the present status of engineering reference libraries in Japan with a view to securing data concerning specific losses and needs and also the most suitable and representative organization to which such a library might be dedicated. If it should develop, as is quite possible, that certain valuable reference libraries have been destroyed, an especially strong appeal could be made to the engineers of America.

New Orleans, Sept. 28, 1923. ARTHUR M. SHAW,
Consulting Engineer.

More About Cat-Tails!

Sir—I read with a great deal of interest the article on p. 509 of the Sept. 27 issue in which you suggest that your Colorado correspondent may find it more profitable to cultivate rather than to eradicate his cat-tails.

If he is looking for suggestions I might say that within the last week I had a call from a man who has been experimenting with a light-weight concrete. When pressed for particulars as to the mix, he informed us that it was a 1:4:12, being respectively one part cement, four parts of sand and twelve parts of chopped up cat-tails. Further investigation disclosed the fact that the last figure was somewhat doubtful and the evidence was more that the mix was one part cement, four parts sand and ½ acre of cat-tails.

If your correspondent can find a use for a concrete which has good nailing and insulating qualities according to our informant, and possesses a resistance to compression of somewhere between 50 and 75 lb. to the square inch (he did not say for how long) we won't make any charge if you want to pass this information(?) along to him.

New York City, Oct. 1, 1923. W. F. LOCKHARDT,
Portland Cement Association.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

Completion of the Providence-Palmer branch of the Grand Trunk R. R. is reported to be under way. This is the 75-mile section of the Grand Trunk R.R. which was abandoned at the outbreak of the war. A considerable portion of the grading had been done at that time.

Flood Waters Rising in Gary, Ind. Sewers after each hard rain have caused an exhaustive survey to be instituted by City Engineer W. P. Cottingham for data in connection with plans for the new municipal pumping station. The new plant will be situated on the Grand Calumet river where the storm sewers empty.

A Party of Officials of the Great Western Ry. of England, including G. Bulkey, docks engineer, has been visiting Canada to study methods of handling coal and grain at Canadian ports. It is also understood that one object of the visit is to interest Canadian concerns in the possibility of using Welsh coal.

Another Substantial Gain in the Net Earnings of the Canadian National Rys. is shown in the August operating reports. The gross earnings were approximately $22,000,000 and the operating expenses $20,000,000, leaving a net of slightly over $2,000,000 as compared with similar earnings for August, 1922, of only a little over $1,000,000. For the eight months ending in August, the net earnings were slightly over $5,000,000 as compared with a deficit of over $1,000,000 for the corresponding eight months in 1922.

Boston City Council Has Voted to accept the act for the extension of Dorchester Tunnel. The work is estimated to cost $4,000,000 and to take from two to two and one-half years. Bids will be advertised within a few months and work will be started early next year. The new statute provides for the extension of the present Dorchester Tunnel from Andrew Square under Boston and Power Streets and Dorchester Avenue; for the construction of tracks in Harrison Square and thence for transportation over the Shawmut branch of the New Haven R.R. to Mattapan Station.

Secretary Hoover Has Appointed a committee consisting of Dr. George K. Burgess, chairman; Dr. F. C. Brown, H. D. Hubbard, and E. W. Libbey, to receive and disburse funds for the relief of dependents of those killed and injured by the explosion at the Bureau of Standards on Sept. 20, 1923. The committee at its first meeting designated Mr. Libbey as secretary and Mr. Hubbard as treasurer. It will be the duty of this committee to receive and disburse funds contributed for the relief of the injured and the families of those who were killed. Some contributions have already been received.

Missouri May Finish $60,000,000 Road Program in 4 Years

The Missouri State Highway Commission has recommended to Governor Arthur M. Hyde that the contemplated time for the completion of the state's $60,000,000 road program be reduced from 10 to 4 years, and that provision be made by the state for road maintenance funds. The commission estimates an average of $200 a mile per year will be required to maintain the roads of the best type and from $300 to $800 a mile for the cheaper types. With sufficient maintenance the commission estimates the road program can be finished in 1927 with 90 per cent of the primary roads of the all-weather type. The Missouri Automobile Club recently went on record as in favor of an additional $5 a year tax on automobiles, the money to be used for maintenance of roads. This would produce approximately $2,000,000 annually.

First Concrete in Piers of Carquinez Strait Bridge

On Aug. 29 the first concrete was poured in the north anchor pier of the vehicular bridge to be erected across Carquinez Strait, one of the upper reaches of San Francisco Bay. Contract for the foundation work has been let by the American Toll Bridge Co., holders of the War Department permit, to Duncanson & Harrelson, contractors of San Francisco.

It is believed that this structure will be the third longest cantilever bridge thus far constructed and the longest one devoted exclusively to vehicular traffic. There will be two 1,100-ft. spans and two 500-ft. spans, the former consisting of two 300-ft. overhanging arms and a 500-ft. supported span. Previous reference to this bridge appeared in *Engineering News-Record*, Jan. 18, p. 135, and Mar. 22, p. 557.

New Sewage Disposal Plans for Madison, Wis.

With unexpectedly rapid increase in amount of sewage flow at Madison, Wis., the present sewage disposal plant (see *Engineering News-Record*, Sept. 11, 1919, p. 510) is already overloaded, the amount of pumpage estimated for 1930 having been reached in 1920. Plans for a new plant southwest of the city have been prepared by E. E. Parker, city engineer, and await approval by the State Department of Engineering. The effluent from the present plant is discharged into Lake Monona, but the new plans provide for discharging the effluent from both plants into the Yahara River which flows out of the lake. A bond issue of $850,000 has been authorized, and bonds for about $250,000 have been sold. Part of the land has been purchased. It is expected to do the excavation during the coming winter and to build the concrete work in the spring.

Many Millions to Be Spent by Southern Pacific

Starts Work on 118-Mile Line Over Cascade Mts.—New Double-Track Into Portland

The 1923 construction and improvement program of the Southern Pacific Company has as its main feature the completion of a new main line from Kirk to Oakridge, Ore. (Natron Cutoff), and line change to reduce grade and curvature from Black Butte to Grass Lake, Calif. Material is being assembled to lay five miles of track out of Oakridge, Ore. this year, on grade constructed in 1913; a contract has been let for 30 miles from Kirk, Ore., and work was started Sept. 1. The remaining mileage is being located.

Double-track work includes: building a new double-track entrance into Portland, Ore., double-tracking portions of transcontinental main line in the Sierra Nevada Mountains between Blue Canon and Truckee, Calif. portions of transcontinental main line in the Pequop Mountains between Wells and Montello, Nev., and portions of San Joaquin Valley main line in Tehachapi Mountains between Bakersfield and Mojave, Calif.

Line Changes

Line changes include: changes in alignment at various points on the main lines between San Francisco and Los Angeles, to reduce running time, involving construction of a tunnel at Rocky Point, near Metz, Calif. and line revision at other points; line change near Mott, Calif., to get rid of a long, high trestle, and another line change together with the construction of second track, and a gauntlet-track bridge, at Yuma, Ariz.

Minor construction includes: branch lines in Imperial Valley, Calif., Calipatria easterly; and in San Joaquin Valley, Magunden westerly; the new freight terminal and automobile handling facilities at Los Angeles, and industrial trackage in San Francisco.

In the line of new structure the company will build new stations at Sacramento and Glendale, Calif., Reno, Nev., and Ogden, Utah; rock crushing plants at Santa Margarita, Calif., Palisade, Nev., and Lucin, Utah; a tie-treating plant for creosoting ties, at Wilmington, Calif., an up-to-date planing mill at Sacramento, and machine shop at Los Angeles.

The program also includes installation of many miles of 110-lb. rail (the heaviest rail in use on the Pacific Coast) to replace 90-lb. steel; ballasting and reballasting of portions of the transcontinental main line Sparks, Nev., to Ogden, Utah, and Los Angeles to El Paso, Texas; construction of and improvement to station buildings at various points; construction of new sidings and extension of passing sidings; installation of automatic train-control devices and additional block signals; enlarging and concrete lining tunnels; construction of team tracks, etc.

Reciprocal Registration Operates in 12 States

Council of State Board of Examiners Reports Plan is Now an Established Fact

Reciprocal registration of engineers in twelve states that have laws regulating the practice of engineering is an established fact. Reports at the meeting in Chicago, Oct. 1 and 2, of the Council of State Board of Examiners indicated that Arizona, Florida, Oregon, Minnesota, North Carolina, South Carolina, Louisiana, Michigan, Iowa, West Virginia, Indiana and Colorado had ratified the articles of agreement on the subject adopted by the Council at last year's meeting. It is a plan to reflect in the examination for a reciprocal "card" a standard even higher than that required by any one of the states in the Council. The cards, which were printed by the Council and made available for the first time at the meeting, are the means of certification of the applicant's qualification from one state to another.

In the states accepting the agreement the card will be *prima facie* evidence of an engineer's qualification for a license in that state but it does not waive legal fees or such information other than evidence of qualification as required to conform to the rules of the examining board.

Qualification Requirements

The principal qualification requirements (See *Engineering News-Record*, July 27, 1922, p. 156 and Oct. 12, 1922, p. 629) are as follows: Qualification shall be determined upon the basis of a detailed professional record on file in the state of which the applicant is already a registrant. Thorough consideration of this record shall constitute examination. Professional experience gained after eighteen years of age shall be considered as beginning only when the applicant shall have entered upon a position in professional engineering work requiring "original thought and responsibility." Examples of when experiences would begin to count are as follows: In the field, a position equivalent to that of a transitman; in the office, design not tracing; in teaching, a full time instructor in a recognized school. A progressive record of engineering experience for ten years, four of which is to be credited by graduation from a recognized school, is required.

Richard L. Humphrey, chairman of the State Board of Examiners in Pennsylvania, presented the situation in his state (not yet a member of the Council). The adverse minor court decision in the Stevenson case (see *Engineering News-Record*, Aug. 2, p. 180) has not halted the work of the board. About 2,500 engineers have registered and $90,000 has been collected.

Reciprocal relations with Mexico and Canada are under consideration by the Council. A. B. Carter, Oregon, stated that his state has established reciprocal relations with British Columbia and Alberta.

The Council will meet next year the second Monday in November at Washington, D. C. The following officers were elected: President, Prof. G. M. Butler; vice president, G. F. Taylor; secretary, T. Keith Legare, Columbia, South Carolina.

One Dismissed as Result of Canal Bureau Investigation

The investigation into irregularities in the purchase of supplies in the canal bureau of the department of public works which was inaugurated by Governor Smith last week under the provisions of the Moreland law is to cover a period of nine years. Exorbitant prices, far in excess of current market quotations, charged the department by an Albany mill supply firm were adduced by the testimony taken last week, but so far no collusion has been shown.

J. W. Grady of Syracuse who was assistant superintendent of the department of public works has been dismissed from the service by Superintendent Frederick S. Greene.

New York Section of Am.Soc.C.E. To Open Fall Meetings

The first meeting of the New York Section of the American Society of Civil Engineers for the 1923-24 season is to be held Oct. 17 at the Engineering Societies Building in co-operation with architectural organizations of the city. The subject will be "The Relationship and Responsibility of the Architect and the Engineer in the Matter of Safety in Building Construction." Speakers include J. Vipond Davies, William Cullen Morris, R. C. Bastress, Robert D. Kohn and John Lowry, Jr.

Power Companies Merge

The Pennsylvania State Water & Power Resources Board has approved the application for incorporation from the Watts Water & Power Co. and the Juniata Water Power Co. These companies expect to build a dam at Iroquois on the Juniata River, which will form a reservoir of 1,500,000,000 gal.

Fred R. Low New President of A.S.M.E.

As a result of the recent election of the American Society of Mechanical Engineers, Fred R. Low, New York City, editor of *Power*, published by the McGraw-Hill Co., has been selected as president for the coming year. The vice-presidents elected are: H. Birchard Taylor, Philadelphia, Pa.; George I. Rockwood, Worcester, Mass.; and W. J. Sando, Milwaukee, Wis. William H. Wiley is the new treasurer. The nomination of Mr. Low for president was made in a convention in Montreal in the summer.

Fail to Get License to Develop Lock 17 on Warrior River

Acting upon the report of its engineers, the Federal Power Commission has concluded that it would not be justified in granting a license to the Alabama Power Co. for the development of power at Lock 17 on the Warrior River. The engineers report that the primary horsepower which could be developed on the Warrior River can be greatly increased by the construction of three storage reservoirs upon the upper reaches of the river and that the power site at Lock 17 is the key to the power situation in so far as the storage reservoirs are concerned; that no power company would undertake to build these reservoirs without first controlling the power site at Lock 17. The engineers also pointed out that the Alabama Power Co. has already undertaken two large projects on the Coosa and Tallapoosa Rivers and that it could hardly be expected to undertake the development at Lock 17 for some years. The Alabama Power Co. has been given until December 1 to file objections to the findings of the Commission's engineers.

Overloaded Truck Wrecks Canal Bridge

A FIVE-TON truck, piled high with radiators and boiler parts, completely wrecked the Hudson County bridge over the abandoned Morris Canal at Garrison Ave., Jersey City, N. J., about midnight, Oct. 2, 1923. The driver escaped without injury and no one else was on the bridge at the time. The bridge consisted of three 75-ft. Pratt pony trusses, pin connected, carried on cast-iron end posts resting on stone masonry abutments. The bridge was built in 1874 and shows no indication of alterations other than the addition of a solid floor. Its capacity was plainly marked on large boards at each end as 8 tons, including truck and load. The steelwork appeared in good condition.

No doubt exists as to the cause of the failure, but the way in which it occurred is not yet clear. There is no indication of failure in any of the top chord members, and as the critical members of the lower chord are all in the mud, they cannot be examined until the debris is cleared away.

Moffat Tunnel Bids Present Unusual Details

Bidding on a six-mile mountain railway tunnel is so unusual that the following note as to the bids for the Moffat Tunnel in Colorado is of particular interest and is from information furnished by R. H. Keays, chief engineer for the Moffat Tunnel Commission.

Under the first call, bids on a unit price basis were to be received on Sept. 12, but no regular bids were received. There was, however, received from Ulen & Co., New York City, an irregular bid on a profit-sharing basis, naming a lump sum of $6,075,000, which included $486,000 profit. In fairness to other parties who might like to present similar propositions it was decided that this bid should not be considered. Immediately after its receipt other bids were received on a similar basis from many different contractors, none of which was considered.

It was then decided by the Board of Consulting Engineers to prepare a blank proposal for the use of the bidders which would put them all on approximately the same basis. This proposal named a preliminary lump sum bid of $5,250,000, using the preliminary quantities as in the plans and specifications, the contractor to be required to name unit prices which, multiplied by the preliminary quantities, would amount to the above sum.

It was specified that if the work cost less than this sum the savings were to be shared equally with the contractor, in which case he would also get his fixed fee as stated below. Assuming that the actual cost of the work amounted to the above sum, the contractor was asked to state a fixed fee for which he was to do the work. If the work cost more than this sum, the contractor was to have 50 per cent of the extra cost deducted from his fixed fee, until his fee was reduced to a minimum fee, which he was also required to name.

A proposal on this basis was received from four bidders: Ulen & Co., New York City; Peter Seerie, Denver, Colo.; James McIlwee, Denver, Colo., and Hitchcock & Tinkler, New York and San Francisco. These last bidders named a maximum and also a minimum fee of $140,000 and their proposition was accepted. All extra work not mentioned in the unit quantities the contractor will perform on a percentage basis, being allowed 5 per cent on the cost of the work in question. In the final accounting, the amount of $5,250,000, mentioned above, will be adjusted in proportion as the quantities may vary from the estimated amount.

Power Developments in Minnesota

The increasing demand for power in the neighborhood of Duluth, Minn., has stimulated great activity on the St. Louis River. Between Cloquet and Fond-du-Lac there is a total fall of 576 ft. The Northwestern Paper Co. is developing 40 ft. of this head at Cloquet and the Phoenix Utility Co., an operating company of the American General Electric Co., has already developed or is developing the remainder of the head except 53 ft. at Midway, and is now preparing plans to develop this last section. The present plans of the Phoenix Utilities Co. will involve an estimated expenditure of $5,000,000.

H. M. Howe Memorial Service

A memorial service for the late Dr. Henry Marion Howe, president of the A. I. M. E. in 1893, will be held at 5 p.m., Oct. 25 in the Cathedral of St. John the Divine, New York City. This is the afternoon of the meeting in New York City of the American Iron and Steel Institute, which has established the Henry Marion Howe Lecture in tribute to Dr. Howe. The memorial meeting will be largely musical, but with short addresses, one of the speakers being Dr. Michael Pupin of Columbia University.

Ford Motor Company to Build Large Tunnel

Detroit Correspondence

The Ford Motor Co. expects to start construction in the immediate future on a new condensing water tunnel at its River Rouge plant. This new tunnel will be approximately 25 ft. in diameter and 12,000 ft. long. The present 12 ft. 8 in. tunnel was driven through very soft material by the shield method, using concrete blocks for the lining and back-filling around the outside with packed gravel. As the new tunnel is to be driven through similar material it is expected that the new tunnel will be driven by the same method that was used in driving the former tunnel.

Steel Erection Derrick Falls

Failure of a guy cable caused the fall of one of four large guyed derricks employed in the erection of the steel frame of the headhouse for the Chicago Union Station, on Sept. 19. By good fortune nobody was hurt and very little damage was done to the steel framing. Both the mast and boom crumpled up where they fell across the floor girders, as shown in the accompanying view, while the head of the mast, with its mushroom plate for the attachment of the guys, was bent back at a sharp angle when it struck the street. These steel derricks are of box lattice construction with 125-ft. masts and 115-ft. booms and can handle 40-ton loads. Each mast is stayed by eight 1¼-in. wire cables, but under the conditions of erection the guys are not of equal length. It is stated that in hoisting a relatively light load with the derrick in question the load on the guys was not equally distributed but became concentrated on one of the short guys, which broke under the strain.

FALLEN DERRICK AT CHICAGO UNION STATION

Bureau of Standards Explosion Caused by Gasoline Leak

Explanation of the cause of the explosion in the dynamometer laboratory of the Bureau of Standards Sept. 20, 1923, resulting in the death of four employees and the injury of six, is given as follows by the board of inquiry which investigated the accident at the request of Herbert Hoover, Secretary of Commerce.

"The explosion was caused by the ignition of a mixture of gasoline vapor and air in the altitude chamber. The research under way was concerned with comparative tests of fuels of differing volatility, and aviation gasoline was under test at the time. The board believes that the presence of the gasoline vapor in the chamber was due either to a leak in the feed line leading to the carburetor of the engine or to a leak from the carburetor due to the sticking of the float mechanism. This conclusion is supported by a remark made by one of the members of the testing staff an instant before the explosion, to the effect that the gasoline readings which he was taking indicated the presence of a leak.

"The condition of the set-up following the fire is such that it is not possible to establish which one of the above causes occasioned the leak. Since it is known that only three gallons of gasoline had been drawn for the test, that the engine had been running from about 11 to 12 o'clock with the chamber open, that the chamber was closed at about 12:30 for the purpose of running at a lower temperature, and that the engine had been operated from about one to two o'clock with the chamber closed, it is believed that not more than a quart of gasoline could have escaped into the chamber. This amount, however, if evaporated would have been sufficient to account for the energy of the explosion.

"The probable source of the ignition was a back-fire through the carburetor. Support to this conclusion is given by the statement of one of the survivors that he heard the engine backfire immediately before the explosion.

"The explosion threw out of the chamber a closed apparatus containing about 10 gal. of heavy lubricating oil and about 5 gal. of toluol, breaking the pipe connections and thus releasing part of the contents which furnished additional fuel for the fire which followed. The explosion also shattered the fuel-measuring system used in the test, which was outside the chamber and contained about two quarts of gasoline. This was the only gasoline supply involved in the fire.

"Special mention should be made," continues the statement, "of the action of C. M. Smith, engineer in charge of the ammonia plant, who after being blown out of the building and badly cut about the head, returned to the wrecked chamber and shut off two ammonia valves, and then went to the refrigerating plant in the basement and operated it to pump the ammonia out of the coils in the wrecked chamber. This action may have prevented further loss of life and the destruction of the entire building by fire."

L. J. BRIGGS.
Chairman.

Board of Inquiry—L. J. Briggs, F. C. Brown, E. F. Mueller, W. S. James, and H. D. Hubbard.

Random Lines

Odds Are Agin 'Em

It is almost hopeless, says the Minneapolis *Journal*, for the autoists to try to destroy all the locomotives at the railroad crossings. The Baldwin works alone are turning out a locomotive every hour.

* * *

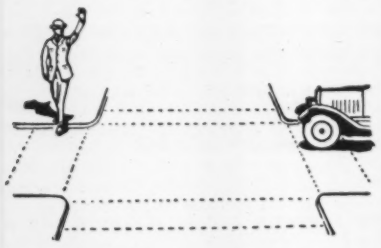
From a sob story in the Chicago *Tribune:*

"And the grief stricken mother went over again the story how she shot her 19-year-old son 'To save his soul.' He wouldn't work, loafed all the time, because he could not get a job at his profession as a Civil Engineer after graduating from the Crane Technical High School. He would not do anything else and chose the easy way of stealing."

* * *

A Magnificent Gesture

In New Orleans they have either achieved the desirable end of humbling the automobile driver or they are breeding an especially virile crop of pedestrians. The accompanying sketch is from the new traffic rules just issued in the Crescent City. After some stirring escapes at Sixth and Broadway in Los Angeles, Michigan Ave. and Madison in Chicago, Market St. near the Palace Hotel in San Francisco, the Campus



Martius at Detroit, and Fifteenth and New York Ave. in Washington—not to mention at all the god-like disdain the New York City motorist displays toward the pedestrian—we wonder at the calm bearing of the southern gentleman crossing Carondelet St. As a gesture it is magnificent, but we trust he has his family well protected with insurance. Probably the driver is not shown in the picture because the language that he is emitting has distorted his countenance beyond fair presentation.

* * *

The Inspired Compositor

According to the Associated General Contractors news letter a well known drill maker has announced a policy of price reduction *commisserate* with the reduction in manufacturing and material costs.

* * *

"Sale of Naval Vessels for Scrapping Purposes" is the title of a catalogue just issued by the Navy Department. We thought that was just what the Washington Conference was aimed to prevent.

Lee H. Landis Is Made General Manager of Alaska R.R.

The Secretary of the Interior has announced the appointment of Lee H. Landis, of San Francisco, as general manager of the Government railroad in Alaska, effective Oct. 1. The appointment of Mr. Landis is the result of an announced decision on the part of the Secretary of the Interior, now that actual construction of this railroad is practically completed, to place an experienced railroad man in charge of its operation.

Mr. Landis' experience in the transportation business began over thirty years ago as an agent and train dispatcher on the Philadelphia & Reading R. R. Since that time he has been a general agent in the operating and traffic departments of the Santa Fe and the Southern Pacific, general manager of the Phoenix & Buckeye R. R., general manager of the Ocean Shore R. R., assistant to the president of the Tidewater Southern R. R., president and general manager of the San Jose Terminal R. R. of California, and general manager of the Fresno Interurban Ry. During the war, Mr. Landis was a major of engineers in the Engineering Corps in Europe for two years, during which time he served in various capacities in the transportation department of the A. E. F. He is now a lieutenant colonel in the Engineer Reserve.

Since the close of the war Mr. Landis has served as industrial commissioner of the Western Pacific Railroad System, with headquarters at San Francisco.

New Zealand Starts Development of Its Vast Power Resources

Estimates of the amount of available water power in New Zealand, forwarded to the Department of Commerce by Vice Consul J. C. Hudson, show a total of 4,076,700 hp., of which 759,700 hp. is in the North and 3,317,000 in the South Island. In the distribution of power resources, the South Island is in an advantageous position as the bulk of its potential supply is located near the deep water sounds of the west coast, where there are many sites suitable for electro-chemical and electro-metallurgical industries.

A program for water power development has been laid out in which the important sites of the North Island will be utilized. These include Lake Waikaremoana, which has sufficient storage capacity to run the proposed generating plant for 21 months without rainfall, and the Waikato River project which tops Lake Taupo. The first installment will involve an estimated expenditure of £15,000,000 for the headworks, plant and transmission line to Auckland, and will develop 50,000 of the 138,000 hp., which it is estimated can be ultimately obtained.

State commitments up to the end of 1923 for the Lake Waikaremoana project amount to £110,000. By the end of 1924 it is planned to spend £1,075,000 when it is expected that 24,000 hp. will be available from this source. The method of financing hydro-electric development in New Zealand is chiefly through State aid, no projects of importance being promoted by private organization. Southland province with some assistance from the State is carrying on its development through the Southland Power Board.

A.G.C. Committee Studying Bidders' Responsibility

In order to define responsibility as applied to construction companies and to devise practical means of selecting responsible bidders for a given project, the committee on ethics of the Associated General Contractors has begun an intensive study. By this procedure the association hopes to remove the disagreeable controversies that frequently result when engineers disqualify contractors as irresponsible bidders. According to an announcement made by the A. G. C., in the co-operative work which the association has been doing with the joint conference on contracts and the American Association of State Highway Officials, the inter-departmental board of contract and adjustment and various local agencies, practically each issue discussed has been connected with the question of a bidder's responsibility. The opinion has often been heard that engineers and public officials would be glad to adopt certain contract principles if they possessed the means for awarding contracts to responsible companies only.

The committee on ethics in undertaking this work is desirous that construction companies throughout the country give it their careful thought and forward to the Washington office of the A. G. C. any suggestions. The committee defines the elements of responsibility as follows: (1) Financial strength, which includes not only a financial statement to indicate the condition of the bidder's business, but a statement of funds available for the project and banking references; (2) personal experience of construction manager, proprietor, partner or company official in charge of construction; (3) construction plant available for the project; (4) construction performance record; and (5) personal references for successful construction service.

The committee suggests that certain qualifications be put upon bidders before they are allowed to submit proposals, instead of after bids are received, so that the principal ground upon which a disqualified bidder can secure taxpayers' injunction, namely, the award of a contract at a higher price, is removed. Various other reasons for qualifying bidders include a saving of the expense in field investigation and estimating on the part of any who cannot qualify for a particular project.

101 Contractors Bid for 11 Road Jobs in North Carolina

The North Carolina State Highway Commission awarded contracts recently for eleven projects. There were 101 bidders for the work. The total mileage let was 72.99 miles, costing, exclusive of the usual 10 per cent for engineering and contingencies, $1,885,718. Of this there were 56.95 miles of standard concrete paving, which cost $30,340 per mile including grading, draining, bridges, culverts and all other items of construction.

The remaining 16.04 miles let consisted of earth or topsoil roads and cost $7,424 per mile including all items of construction mentioned above.

The reinforced concrete bridges and culverts, included in the above figures, amounted to $178,871, or about $2,450 per mile of road constructed.

Civil Service Examinations

NEW YORK STATE

For the following Civil Service examinations apply to the New York State Civil Service Commission, Albany, N. Y. The positions are open to applicants not residing in the state of New York. Both examinations are to be given on Nov. 3.

Assistant Sanitary Engineer—New York State Department of Health, salary $3,000 to $3,500. The duties of the position require a knowledge of the design, construction, operation and supervision of water supply systems, water purification works, sewerage and sewage disposal systems and prevention of stream pollution; also four years' experience in such work.

Assistant Sanitary Engineer—New York State Department of Health, salary $2,100 to $2,500. The duties of the position include investigations and reports on construction and operation of water supply and sewerage systems and water and sewerage treatment works, community sanitary conditions.

Engineering Societies

Calendar

Annual Meetings

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga., Nov. 12-16.

CITY MANAGERS ASSOCIATION, Lawrence, Kansas; Annual Meeting, Washington, D. C., Nov. 13-15.

AMERICAN ROADBUILDERS' ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 14-18.

The Engineering Institute of Canada, Montreal Branch, resumed on Oct. 4 its weekly meetings, this week's topic being "The St. Lawrence Deep Waterways" presented by E. A. Forward, consulting engineer, Montreal.

The Society of Terminal Engineers held its regular meeting, with a dinner, in New York City Oct. 9 and on the subject, "Co-Ordination of Railroad and Marine Terminals," Col. Edward Burr, formerly U. S. district engineer officer, first New York district, was the speaker, the discussion being taken up by Francis Lee Stuart, J. J. Mantell, vice-president of the Erie R.R., Col. Charles Hine, and E. H. Lee, vice-president of the Chicago & Western Indiana R.R.

The Engineers Club of Philadelphia and the Philadelphia Section of the American Society of Civil Engineers will hold a joint session during the afternoon and evening of Oct. 16 at which the pollution of streams with special reference to industrial wastes will be discussed. The speakers will be Dr. W. H. Frost, surgeon of the U. S. Public Health Service, George W. Fuller, C. A. Emerson, Jr., Col. F. C. Boggs, Almon L. Fales, W. L. Stevenson, Maj. J. A. Vogleson, and J. W. Ledoux.

The Boston Society of Civil Engineers at its monthly meeting Oct. 19 will have as speakers giving "Brief Talks on Engineering and Construction," W. F. Williams, commissioner of public works for Massachusetts; J. W. Rollins, of Holbrook, Cabot & Rollins, contractors for masonry and concrete construction; W. H. Sayward, secretary of the Master Builders Association; J. Parker Snow, consulting engineer; C. T. Main, industrial engineer; and C. R. Gow, engineer and contractor for foundations.

Personal Notes

ERNEST R. ROBINSON, now water supply engineer for the Solvay Process Co., chemical manufacturers, Syracuse, N. Y., was formerly engaged in civil engineering work for the Hudson River Bridge Co., of New York City.

H. E. TEWELES, who had been constructural designer for the United States Gypsum Co., Chicago, Ill., is now connected with Albert Kahn, architect and engineer, Detroit, Mich., in the same kind of work.

JOHN R. NICHOLS, formerly chief engineer of Monks & Johnson, Boston, Mass., has opened a consulting engineering office at 161 Devonshire Street, Boston, for practice in the design and construction of industrial plants and general structural and construction engineering.

H. B. MILLER, assistant city engineer, Chicago, has been dismissed from office by Col. A. A. Sprague, commissioner of public works. Mr. Miller held his position on temporary appointment by the former administration. Major Myron B. Reynolds, engineer of waterworks design, is acting assistant city engineer, pending a permanent appointment.

EXUM M. HAAS, Cleveland, Ohio, who until recently was manager of the railroad department of the H. K. Ferguson Co., announces that he is open for engagement as consulting engineer in locating, laying out and designing railroad shops and terminals, and gap crane and other types of locomotive erecting.

FRANCESCO MAURO, engineer and architect, has terminated his connection with Martin J. Lide, and has opened an office for the practice of structural engineering and architecture in the First National Bank Bldg., Birmingham, Ala.

PRESTON L. FITE, formerly with the North Carolina State Highway Commission, Greensboro, N. C., and the California State Highway Commission, Sacramento, Calif., has returned to work with the North Carolina commission as resident engineer at Reidsville, N. C., on an 8-mile concrete road project.

MAURICE DEUTSCH, architect and engineer, announces the removal of his offices from 50 Church St., New York City, to the 12-story building which he recently purchased at 35-39 Maiden Lane, New York City, and to which he is adding another floor.

ORLEY GREY, Wabash, Ind., superintendent of the Fort Wayne highway district has resigned to enter the contracting business.

S. J. NORRIS, civil engineer, Oroville, Calif., has been appointed chief engineer of the Honcut-Yuba Irrigation District in Yuba County, Calif.

RUSSELL M. DUFF, Canton, Ohio, has resigned his position as superintendent of state highways in Columbiana County and will take up post-graduate work at Cornell University.

OLIVER ANTRUM HALL, formerly designing engineer, Alaska Road Commission, with headquarters at Juneau and Anchorage, Alaska, has severed his connection with the commission and opened up an office in the Seaboard Building, Seattle, Wash., as engineer on bridges and buildings.

Obituary

MAJOR DANIEL D. PULLEN, Corps of Engineers, U.S.A., died Sept. 24 in a hospital in Washington, D. C., after an illness of two months. He was 38 years of age. Major Pullen was a native of Washington state and a West Point graduate of 1910. He served with the Engineers in France, rising from lieutenant to major, and won the Distinguished Service Cross, the Croix de Guerre and two citations.

WILLIAM P. JONES, resident engineer during the building of the Georgetown loop on the Colorado & Southern R.R., engineer for public works at Denver, Colo., from 1889 to 1901, died suddenly, Sept. 24, at the home of his sister in Louisville, Ky.

F. W. COOK, vice-president of the San Antonio Portland Cement Co., died Sept. 3 in a hospital in Chicago after a two months' illness. Mr. Cook was born in Kentucky and was educated in the University of Indiana and the University of Heidelberg, Germany. He was connected with the San Antonio Drug Co. from 1895 to 1908 and in the latter year organized the San Antonio Portland Cement Co., which is the successor to the older Alamo Cement Co., organized in 1880.

A. H. ANDERSON, professor of engineering at the University of Wisconsin, died at his home in Madison, Wis., Sept. 1. Prof. Anderson was for several years professor of steam and gas in the department of engineering at the University of Wisconsin.

FORRES MCGRAW, secretary-treasurer of Swanson-McGraw, consulting engineers, New Orleans, La., was electrocuted in an accident at the Plaquemine, La., water-works Sept. 19 and death was instantaneous. Mr. McGraw was 27 years old, and the son of John McGraw, general agent at New Orleans of the Southern Pacific Ry. After graduation from Tulane University, he entered the employ of Fairbanks-Morse Co. and later with Mr. Swanson, an employee of that company, established the firm of Swanson-McGraw, consulting engineers. During the War he served as an instructor at Camp Beauregard and at Fort Sill.

From the Manufacturer's Point of View

A Point of Contact
Between Maker and User of
Construction Equipment and Materials

Notes on Care of Wire Rope

From a paper by William Constable, mechanical and electrical engineer, Republic Iron & Steel Co., presented Aug. 30 at the annual meeting of the Lake Superior Mining Institute.

Rope used for hoisting and haulage usually ranges in diameter from 1 to 2¾ in.

Grooved hoisting drums are preferable to flat-faced drums; pitch of grooves should be ¼ in. larger than rope diameter; diameter of drum should be not less than 60 times diameter of rope.

Diameter of head sheave for shaft hoist should be 80 times diameter of rope. The following groove diameters on sheaves are recommended: For rope ¾ to 1 in. diameter, 1/16 in. larger groove diameter; for rope 1 1/16 to 2¼ in. diameter, ¼ in. larger groove diameter; for rope 2⅝ in. and upward, 3/16 in. larger groove diameter.

Attachment of rope to cage or skip should be by means of a wire rope socket with zinc attachment to develop full strength of rope.

Abrasion of rope on inclined haulage work should be avoided by the installation of rollers not less than 6 times the rope diameter and spaced 25 to 30 ft. apart.

When cutting steel wire rope it is essential to place three sets of seizings on each side of the cut to prevent disturbing the uniformity of the rope. Annealed iron wire should be used for seizing purposes.

A wire rope received in a coil should be unrolled on the ground like a hoop and straightened out before attempting to pass it around sheaves.

Wherever a spliced eye, clip or clamp connection is used, it is necessary to employ a wire rope thimble around which the rope is passed to protect it from being mashed or distorted when strain is applied.

Reverse bends should be avoided in wire rope instalation.

Lubrication of wire rope is highly important. A lubricant applied hot will generally give good service because in its heated condition it will penetrate and then, upon cooling, will congeal into a plastic filler throughout the rope.

Japan Admits Building Materials Free Until March 31

Building materials and the necessities of life have been exempted from import duty until March 31, 1924, by virtue of an imperial ordinance promulgated in Japan according to advices received from the Consulate General of Japan, New York City, and forwarded to the Department of Commerce. Under the same imperial ordinance, the import duty on automobiles, other than motor trucks, but including automobile parts and motive machinery, has been reduced by one-half for the same period. Information concerning specific commodities affected by this decree will be furnished upon request by the Department of Commerce, Washington.

New Financing for Lakewood Company

New financing by the Lakewood Engineering Co., Cleveland, Ohio, involves the issue of $400,000 first mortgage, ten-year, 7 per cent sinking fund gold bonds, which are being offered for public purchase at par and accrued interest to yield 7 per cent. The bonds are in denominations of $1,000, $500, and $100, interest being payable semi-annually.

The company, which was founded in 1896, manufactures concrete mixing and handling machinery and trucks and trailers for factory and warehouse haulage. During the year 1922 the company made a profit applicable to interest of $143,609 and for the first six months of the current year earnings have totaled $86,957.

Builders Shun Proper Equipment, Says Manufacturer

A letter to the Editor

Sir—You may be interested to know that the editorial "Building Methods Primitive," on p. 498 of the Sept. 27 issue of *Engineering News-Record* crystallized some thoughts of the writer. On the majority of small building operations you will see time lost and costly errors made because a level-board and string are being used instead of a surveying instrument such as the convertible level or transit. In addition to our own make there are several comparatively low-priced yet reliable instruments on the market at convenient terms to aid the small builder in establishing accurate lines and levels quickly.

In the writer's opinion the cause for the general backwardness in the development of machines for individually small operations is the atmosphere of "doing" in which the builder lives as compared to an atmosphere of "planning." He can be critized more fairly for being too "practical" than he is justified in claiming the engineer to be too "theoretical."

The Warren-Knight sales efforts of necessity have been stronger in selling builders the idea of utilizing a convenient and reliable convertible level or a builders' transit than on the effort to sell our particular trade name. Builders will find manufacturers ready to give the effort for developing time-saving machines for individually small operations if they would show more interest in them. Since the builder is so engrossed in rushing around on a job in actual operation or in hunting for more contracts, perhaps it would pay him to increase his overhead to the extent of securing the services of an engineer who could reduce operating costs by utilizing such equipment as is now available.

This condition covered by your editorial is widespread and worthy of attention.

J. O. PRESTON,
Warren-Knight Co.

Philadelphia, Oct. 1.

Construction Equipment at Mining Congress

Exhibit Includes Variety of Heavy Machinery—Equipment Problems Discussed in Open Forum

Engineering News-Record Special Report

FOR the contractor or the manufacturer of construction equipment the two features of special interest at the American Mining Congress, held in Milwaukee Sept. 24-29 were an exhibit of machinery and appliances and an open forum or series of discussions on subjects relating to mining equipment and methods.

Exhibits — An extensive display of machinery and equipment used in mining and also in metallurgical work filled the floor of the main hall in the Municipal Auditorium. Many of the machines were in operation and one enterprising exhibitor of a mucking or coal-loading machine had dumped a few tons of coal into his exhibit space, the machine continually digging this up from one spot and depositing it in another. On a vacant lot outside the hall another machine of the same type was handling a rock pile.

The number of visitors was rather small, since many of the men attending the Congress were interested in legislative, social and economic matters rather than in actual mining operations. Much of the equipment exhibited is or might be employed on construction work. Without attempting to enumerate all the exhibits the following list indicates appliances of use for general construction purposes rather than for mining exclusively.

RANGE OF EXHIBITS

1. Excavating machinery—Bucyrus and Pawling & Harnischfeger.

2. Mucking machines for mine or tunnel work—Hoar, Jeffrey, Joy, Myers-Whaley, Shuveloder and Thew. The last named company showed the new machine designed by engineers of the St. Joseph zinc mines and described in *Engineering News-Record* of May 31, p. 981.

3. Portable conveyors for loading cars and handling materials—Manierre and Ottumwa.

4. Industrial locomotives, steam—Baldwin, Heisler and Lima; electric—General, Goodman, Ironton, Jeffrey, Mancha and Westinghouse; gasoline—Milwaukee.

5. Mine and dump cars—Lorain and Western.

6. Mine and industrial track, ties and switches—Bethlehem and Lorain.

7. Drills — Sanderson-Cyclone and Diamond.

8. Pumps—Layne & Bowler, Midwest, Prescott, and Worthington.

9. Wire Rope—Broderick & Bascom, MacWhyte and Williamsport.

10. Explosives—Atlas, Hercules and DuPont.

11. Screening Plants—Allis-Chalmers, Roberts & Schaefer, Robins Belt and Smith Engineering.

12. Chain drives — Chain-Belt and Morse.

Exhibits of a special character were those of the U. S. Bureau of Mines, including mine rescue work and safety appliances, and the Colorado School of Mines. The Milwaukee Public Library exhibited shelves of its books on mining and mining machinery; an attendant was in charge to give information. The

Milwaukee Public Museum also had a case of ore specimens as an example of the exhibits to be found in the museum.

Open Forum—A series of discussions on mine equipment problems was based on practical questions submitted by both manufacturers and mining men so as to bring out the viewpoints of the makers of equipment and the men who use it. A discussion on rock drills related largely to the value of air-drills and churn or well-drills for open workings, but it was stated that no churn-drill now available has sufficiently low head room for use in mines. Economic use of explosives in coal mining was actively discussed by mine operators, miners, state mining officials and makers of explosives. It was generally agreed that there is need for a campaign of education as to the use of explosives. A reduction in the present excessive amount of explosive per ton of coal produced would result in a greater proportion of coal in the larger and more valuable sizes, while there would also be greater safety in mining. It was voted to appoint a committee to consider such a campaign.

The program of discussions was not followed strictly, but among the subjects listed were the following, some of which have a relation to engineering construction work: Shoveling and loading machines for underground work; the caterpillar mount for shovels; mine transportation; crushing and screening; hoisting plant; pumps and mine drainage; underground power equipment and transmission; drilling machines and drill steel; wire rope; use of traveling cranes at mills and smelter plants; applications of welding in mining work; track equipment and standardization of gage for mine tracks; gasoline, electric trolley and storage battery industrial locomotives; safe equipment for hoists, pumps and loading machines in gaseous mines.

Business Notes

WALSH & MCGEE STEEL CO., New York, announces that its new rolling mill constructed on tidewater at Newark, N. J., has begun operation. The mill is designed especially for rolling light steel sections such as ¼ and ⅝-in. round, plain and deformed bars, small angles, channels, flats, tees and other sections.

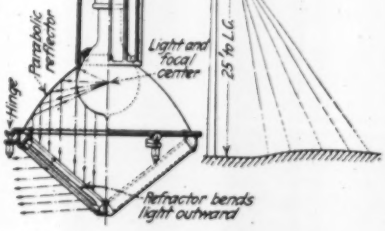
LINK-BELT CO., Chicago, according to an announcement just made by its president, Charles Piez, has purchased the Meese & Gottfried Co., San Francisco, Los Angeles, Seattle and Portland, to improve its distributing facilities on the Pacific Coast which had previously been handled by subsidiary organizations under the names of the Link-Belt Northwest Co., of Seattle, and the Link-Belt Pacific Co., of San Francisco. Meese & Gottfried Co., and its predecessors, have been manufacturers of power transmission machinery and distributors of conveying and transmission machinery on the Coast for more than forty years. It is the intention of the new owners to add to the facilities and enlarge present stocks, so that prompter service to its customers will be insured. The new organization will be known as Link-Belt Meese & Gottfried Co., with headquarters at San Francisco. The officials will be: Charles Piez, chairman of the board; B. A. Gayman, president; Harold H. Clark, vice-president and sales manager; Leslie W. Shirley, treasurer; and Richard W. Yerkes, secretary.

Equipment and Materials

Highway Lighting Unit Throws Long Beam Parallel to Road

Through a combination of parabolic reflectors and refractor prisms a highway lighting unit, developed by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., effects a marked economy in the distribution of its illumination by casting its rays along the road in a long, narrow path. Another feature of the unit is the elimination of glare which is not only objectionable to the driver of a vehicle, but has been responsible for many road accidents.

As shown in the accompanying sketches, the lighting unit consists of a porcelain housing containing a Type C lamp, a silver-plated parabolic reflector, and a double set of refracting prisms. The unit is arranged for suspension from a series of interchangeable fittings to be fastened to brackets, mast arms or span wires, as mounting



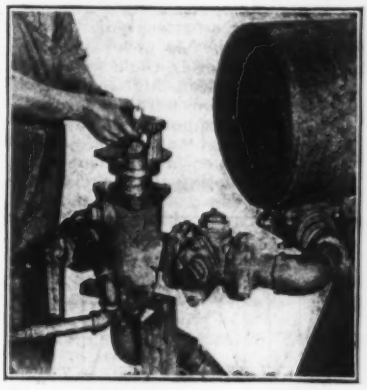
conditions require. The unit is generally placed at least 25 ft. above the road surface.

The parabolic reflector is so arranged with relation to the refractor prisms that all of the light is distributed without waste in a direction parallel to the roadway. The glare elimination feature is accomplished by positioning the edge of the reflector so that the light in a line parallel to the direction of travel is cut off at a direct angle of 14 deg. below the horizontal—the angle which has been determined by exhaustive tests to be the most practical. The complete highway lighting unit weighs 100 lb.

New Balanced Three-Way Valve for 21-E Paving Mixer

A new three-way balanced valve, designed to prevent leakage by the elimination of metal-to-metal seats common on former types, has been perfected by the Koehring Co., Milwaukee, and is now installed as standard equipment on its 21-E pavers. All of the valve parts which come in contact with water are made of either bronze, brass, rubber or leather, preventing corrosion. The valve, which is equipped with rubber discs and leather plunger (standard Jenkins parts), is balanced, automatically operated, non-freezing, self-draining and accessible.

Inspection of the valve can be made easily by removing three bolts and one pin connection, allowing the entire unit to be pulled out of the valve body, as shown in the accompanying illustration. The valve can be dropped back into place without any fitting or adjusting. To turn the three bolts down and make the pin connection to the operating levers, is only a few minutes' work. A removable house protects the valve and outside valve parts from stone, sand

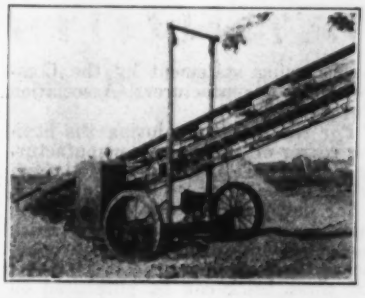


and cement which may drop from the charging skip.

An additional time-saving feature is the automatic opening of the valve to discharge water into the drum by means of an arm which opens the valve when the skip is raised. The time of opening the valve is adjustable in the valve-operating mechanism. A hand control is also provided for operating the valve.

Rubber-Tired Wheels for Construction Equipment

A development in its agricultural type of wheel is announced by the Geneva Metal Wheel Co., Geneva, Ohio, in the form of rubber-tired wheels for construction equipment. With such wheels equipment may be hauled from one job to another by motor trucks at higher speeds than is possible with metal rimmed wheels and also with less damage to the equipment from vibration and impact. The new type of wheel, shown in the accompanying illustration of a mechanical loader handling road material in Ashtabula County, Ohio, has hubs equipped with a



special type of roller bearing. The production of rubber-tired wheels is a new field for the Geneva company and its plant is now being equipped to manufacture this equipment for all standard rubber tire sizes.

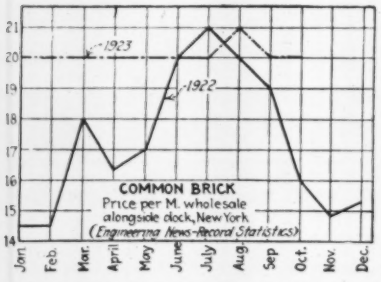
Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Brick and Cement Importations Increasing

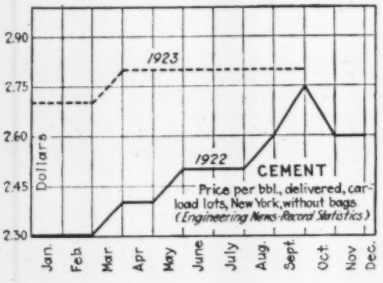
Foreign Brick Receipts During Second Quarter 1200 Per Cent Above 1922—Slight Gain In Cement

Although importations of foreign building materials has never yet been an important factor in the construction situation, the present high price level has given rise to considerable discussion of the subject. Importations of brick and cement are light as compared with domestic production and consumption, but it is worth noting that they appear


1923
1922
COMMON BRICK
Price per M. wholesale alongside dock, New York
(Engineering News-Record Statistics)
Jan. Feb. Mar. April May June July Aug. Sep Oct. Nov. Dec.

to be increasing. In April, May and June of this year 10,379,000 common brick came in through the port of New York, against only 749,000 in the same quarter of 1922. Cement imports through New York were heavier by 41,858 tons in this same quarter of 1923 than one year ago. In addition, 9,687 tons of white, non-staining cement were imported against none last year.

That American brick men are appreciative of the situation is evidenced by


1923
1922
Dollars
CEMENT
Price per bbl., delivered, carload lots, New York, without bags
(Engineering News-Record Statistics)
Jan. Feb. Mar. Apr May June July Aug. Sept Oct. Nov Dec.

the following statement by the Common Brick Manufacturers' Association of America:

"For the first time during the business career of anyone now manufacturing brick some competition is felt from foreign made brick. This is apparent so far only in the New York market, where considerable quantities of brick from Germany and Holland are reported to be coming in. It is stated that these brick can be purchased on board ship at German and Holland ports for $4 a thousand. It is apparent at once that American manufacturers cannot compete with this low production cost even after transportation and handling on this side of the ocean has been absorbed. This competition is not likely to reach far inland, but would affect Atlantic ports unless the American manufacturers in those locations find some protection."

The amount of foreign shipments to New York in the second quarter of 1922 and 1923, furnished by the Bureau of Foreign and Domestic Commerce, is as follows:

	1922	1923	
	Thousands	Thousands	Invoice Value
April	220	5,694	$31,916
May	217	2,706	22,741
June	312	1,979	17,009
	749	10,379	$71,666

The Bureau of Foreign and Domestic Commerce, of the Department of Commerce, reports that the imports of hydraulic cement in June, 1923, amounted to 11,559 bbl. The total imports in 1922 amounted to 323,823 bbl.

The exports of hydraulic cement in June, 1923, were 77,203 bbl. valued at $236,166.

The effect of competition always shows in the prices. That foreign entry into American brick and cement markets has not reduced prices is proved by the charts for New York.

Recent Unit Bids Throughout the Country

Although it is impossible for *Engineering News-Record* to quote formal prices at hundreds of centers throughout the United States, a workable acquaintance with construction cost in outlying districts may be had by studying the unit bids published in Construction News. For the reader's convenience representative bid prices on various materials and operations applying on a number of the more important contracts awarded during the last two months are presented in the table.

UNIT-BID PRICES ON IMPORTANT MATERIALS AND OPERATIONS IN RECENT CONTRACTS AWARDED

Where Located	E.N.-R. Issue	Nature and Extent of Job	Unit Bid Price
Arkansas	Sept. 6	22 mi. single track railway	$125,000
Calif., Merced	Sept. 20	6,000 bbl. cement, per bbl.	3.79
Calif., Los Angeles	Aug. 30	100,000 cu.yd. dredging, per cu.yd.	.244
Calif., Los Angeles	Aug. 16	2,800,000 cu.yd. dredging, per cu.yd.	.1575
Fla., Sebring	Aug. 2	8,500 cu.yd. earth excav., per cu.yd.	.33
Ia., Clinton	Sept. 13	55,259 cu.yd. excavation, per cu.yd.	.30
		2,817 cu.yd. loose rock excav., per cu.yd.	.50
		5,615 cu.yd. solid rock excav., per cu.yd.	1.75
Ia., Des Moines	Sept. 13	28,000 sq.yd. 8 in. concrete, per sq.yd.	2.66
Ia., Waterloo	Sept. 6	91,379 cu.yd. excav., per cu.yd.	.275
		80,000 cu.yd. channel, per cu.yd.	.375
Ia., Des Moines	Aug. 30	43,324 sq.yd. vitrified brick on 6-in. concrete, per sq.yd.	3.25
Ia., Denison	Aug. 30	98,388 cu.yd. excav., per cu.yd.	.235
		15,100 cu.yd. channel, per cu.yd.	.35
	Aug. 30	1,300 lin.ft. 8-in. tile, per lin.ft.	.18
		1,350 lin.ft. 6-in. tile, per lin.ft.	.135
Ia., Anamosa	Sept. 27	106,660 cu.yd. excav., per cu.yd.	.22
		8,700 cu.yd. channel, per cu.yd.	.48
	Sept. 27	30,690 ft. 6-in. tile, per lin.ft.	.122
		540 ft. 8-in. tile, per lin.ft.	.178
		1,325 ft. 12-in. tile, per lin.ft.	.34
Ill., Chicago	Sept. 20	2,000 bbl. portland cement, per bbl.	2.50
Ky., Louisville	Aug. 9	Pine No. 1 common, 1,670 pieces 2x4 @ 6x8 in. x 20 ft., per M.	32.00
Mass., Haverhill	Sept. 6	6,000 cu.yd. dredging, per cu.yd.	2.20
		8,000 cu.yd. earth excav., per cu.yd.	3.575
		50 cu.yd. rock excav., per cu.yd.	22.00
Mich., Lansing	Aug. 9	27,314 cu.yd. excav., per cu.yd.	.55
		77,837 sq.yd. 8 in. con. pavement, per sq.yd.	1.47
Michigan	Aug. 9	54,038 cu.yd. excav., per cu.yd.	.65
		85,097 sq.yd. 8-in. rein.-con. pavement, per sq.yd.	1.46
Minn., St. Paul	Sept. 20	20,000 bbl. portland cement, net, del., per bbl.	2.80
Minn., St. Paul	Aug. 23	6,645 sq.yd. 3-in. vertical fibre brick, per sq.yd.	1.62
		4,000 cu.yd. crushed stone or gravel, per cu.yd.	2.60
		260 tons asphalt, per ton	21.30
		80,000 lb. asphalt filler, in drums, per ton	26.60
Miss., Senatobia	Aug. 9	520,680 cu.yd. canal excav., per cu.yd.	.975
Miss., Gulfport	Aug. 23	15,395 sq.yd. bitulithic, per sq.yd.	1.37
		16,300 sq.yd. concrete base, per sq.yd.	1.60
New York	Sept. 6	15,000 cu.yd. earth excav., per cu.yd.	2.00
		100 cu.yd. rock excav., per cu.yd.	6.00
		1,700 bbl. cement, per bbl.	4.00
O., Canton	Sept. 27	1 mi. monolithic type brick	60,943.00
O., Cleveland	Aug. 30	1¼ mi. 24-in. c.i. main	123,070.00
		1¼ mi. 36-in. c.i. main	216,783.00
Okla., Fairfax	Aug. 23	29,110 sq.yd. vertical fibre brick, per sq.yd.	3.95
		9,980 cu.yd. earth excav., per cu.yd.	.90
		140 cu.yd. rock excav., per cu.yd.	2.90
Okla., Blackwell	Aug. 2	8,600 sq.yd. vertical fibre brick, per sq.yd.	3.60
		4,800 lin.ft. curb and gutter, per lin.ft.	1.15
		3,500 cu.yd. earth excav., per cu.yd.	.80
Oregon	Sept. 13	38,000 cu.yd. common excav., per cu.yd.	.32
		3,000 cu.yd. solid rock excav., per cu.yd.	1.00
Tenn., Memphis	Aug. 23	15,000 bbl. cement f.o.b. Memphis siding, per bbl.	3.11
Tex., Ennis	Aug. 23	14,500 ft. 10-in. class B, c.i. pipe, per ft.	2.60
Tex., Abilene	Aug. 9	40,000 sq.yd. 2-in. bitulithic pavement, per sq.yd.	2.52
Utah, Salt Lake City	Sept. 6	2,174 cu.yd. common excav., per cu.yd.	.95
		1,550 cu.yd. borrow, per cu.yd.	.50
	Sept. 6	9,625 cu.yd. common excav., per cu.yd.	.50
		4,375 cu.yd. borrow excav., per cu.yd.	.50
Washington	.....	62,000 cu.yd. earth excav., per cu.yd.	.55
		44,730 cu.yd. common excav., per cu.yd.	.50
		3,300 cu.yd. loose rock excav., per cu.yd.	.80

Production and Materials Stocks In Eleven Cities

Substantial Reserves of Brick and Lumber—Cement Output Highest on Record—Drop in Steel and Iron Output

Iron and Steel—Production has fallen off somewhat in both iron and steel during the last month. The average daily pig-iron output during September was approximately 99,811 tons, against 110,816 in August and 124,764 in May, which was the highest month in the history of the industry. The September steel ingot output totaled 3,159,283 tons against 3,506,755 during August and 4,000,695 in May, which was the peak month of the year, according to the American Iron and Steel Institute. While there has been a marked decrease in production and demand, consumption has been kept up in that buyers have been drawing heavily upon their reserve stocks.

Lumber—The present output is about 5 per cent above normal as against 7 per cent above, one month ago and 3 per cent below normal one year ago. Shipments are 105 per cent and orders 115 per cent of normal production, according to the National Lumber Manufacturers' Association. While production fell off slightly, shipments and orders gained during September. One year ago production was 97 per cent of normal with shipments 90 and orders 85 per cent of normal production. The following table shows lumber movements during the four weeks ending Sept. 29, compared with the preceding four weeks:

	Four Weeks Ending— Sept. 29, Ft. B.M.	Sept. 1, Ft. B.M.
Cut	1,078,921,770	1,082,683,351
Shipments	963,864,271	925,944,072
Orders	1,022,552,432	887,295,317

Cement—The August cement output was the heaviest on record, with 12,967,000 bbl. against 12,620,000 for the month preceding. August, 1922, however, totaled 11,664,000 bbl. Reserve stocks throughout the entire country Sept. 1 totaled 6,077,000 bbl. as against 5,716,000 for the corresponding period in 1922, according to the Geological Survey. Compared with this time last year, the cement situation is one of increased production, shipments and stocks on hand.

Brick—Report of the Common Brick Manufacturers' Association of America as of Sept. 1 shows 250,176,000 burned brick on hand at yards throughout the country, compared with 179,574,000 on Aug. 1. There has been a slight decrease in orders on books with a corresponding increase in stocks on hand, since there has been no slackening of production. Northern brickyards are storing brick in anticipation of a heavy 1924 demand. Many of the plants in the agricultural states are closed on account of insufficient demand for brick.

San Francisco—Warehouses fairly well stocked with lime, track supplies and blue annealed steel sheets; large supplies of steel structurals, bars, triangle mesh, metal lath and common brick. Large natural reserves of road oils and asphalt. Plenty of hollow tile, sewer pipe, drain tile, cement and galvanized sheets.

Los Angeles—Supply of building materials keeping pace with demand, with the possible exception of structural steel. Shipments of foreign cement arriving in the harbor.

Denver—Hollow tile and sewer pipe stocks low. Lumber trifle below normal. Plenty of brick.

(Continued on p. 622)

Japanese Preparing to Order Quantities of Supplies

Lumber, Steel, Concrete Mixing Machinery and Galvanized Steel Sheet Inquiries Principal Factors

Japan will be in the market for about 260,000,000 ft. of lumber within the next few months, as a preliminary order, the Department of Commerce has been informed. How much of this is to be purchased in the United States depends upon price and delivery. Japan will also seek some steel in this country, but probably not more than 20,000 tons has already been placed with American and Canadian mills.

The U. S. Department of Commerce will take no part in the purchases to be made by Japan, its duty ending with the message asking the co-operation of building materials manufacturers to prevent undue price advances in the face of an emergency. The Japanese Government is assured by the Department that American materials manufacturers will be able to handle all orders from Japan with promptness and dispatch. All transactions will be handled directly with the building materials producers by the Japanese, particularly through such agencies as the Metropolitan Reconstruction Board at Tokio.

Numerous small orders have already been received by American producers for electrical equipment and accessories, wire, wire nails and galvanized steel sheets. Considerable interest is also displayed in motor trucks and railway car equipment. The Ransome Concrete Machinery Co. of Dunellen, N. J., has already shipped an initial order consisting of twenty-seven concrete mixers and several steel towers to the devastated area. Lumber requirements are estimated at three billion feet.

CONDITIONS OF MATERIALS STOCKS IN IMPORTANT CENTERS

Stocks on hand in approximate figures, example: (Common brick, Denver, 5,000,000); time required for delivery of carload lots to city job, example: (Sewer-pipe Atlanta, 4 to 5 days); and stocks on hand in general terms, example: (Cement, Cincinnati, scarcity)

	San Francisco	Los Angeles	Denver	Minneapolis	Detroit	Chicago	Cincinnati	New Orleans	Atlanta	Philadelphia	New York
Sewer pipe	Stocks in good shape	No shortage	Supply low	Ample	Normal	Supply low; del. take 1 week to 10 days	Plenty	Scarcity of 4-in. pipe	Del. take 4 to 5 days	Supply ample	Small stocks in sizes above 6-in.
Cement	Well supplied	Sufficient; foreign shipments arriving	Enough	Plenty; del. prompt	No local shortage	Enough	Scarcity	Plenty	50 to 60 cars	No stocks in city; mill del. prompt	Dealers' stocks small; mill del. prompt.
Lime	Fairly well stocked	Plenty	Sufficient	Enough	Well supplied from local and Ohio kilns	Plenty	Enough	No shortage	70 cars	Normal	Market well supplied
Common brick	Large reserves	Demand being met	5,000,000	Large stocks	Plenty in dealers, yards	Sufficient	Ample	Sufficient	Plenty	Supply coming in to meet demand	Heavy reserves being piled in Hudson River district
Hollow tile	Plenty	Supply equal to demand	Stocks low	Sufficient	Small supply	Del. take one week	Plenty	Enough	4 to 5 days	Small stocks	Dealers' stocks small; prompt del. by water
Lumber	Heavy shipments to Japan	Demand not greater than supply	Trifle below normal	60,000,000 ft. in Twin City yards	Stocks decreasing at approach of inventory	Del. take 30 to 60 days	Sufficient	Stocks low on yel. pine	Plenty	Well stocked except West Coast lumber	Del. take 4 to 5 weeks from mill
Asphalt	Unlimited native reserves	Native reserves	Sufficient	Ample	Moderate stocks; del. prompt.	Plenty	Ample	No market	60 to 70 cars	Great scarcity	Heavy reserves in N. J.
Structural steel	Plenty structurals, low on rivets	Supplies now up to requirements	Warehouses well stocked	Enough in warehouses	No shortage	Del. on reinforcing bars take 30 days	Pipe stocks low; other steel items plentiful	Normal	4 to 5 cars	Supply ample for small tonnages	Warehouse stocks sufficient; demand light

(Continued from p. 621)

Minneapolis—Stocks of all materials ample with deliveries prompt. Lumber stocks trifle below normal with an estimated 60,000,000 ft. in Twin City yards, wholesale and retail.

Detroit—Small stocks of hollow tile on hand. Lumber reserves decreasing at approach of inventory time; dealers buying on hand to mouth basis. No local shortage of cement but scarcity reported in nearby localities owing to heavy demand by State Highway Department.

Chicago—Sewer pipe stocks low; deliveries take from one week to ten days. Lumber mill shipments take from thirty to sixty days. Japanese demand has not yet affected the lumber market in this district. Hollow tile demand slightly above normal for this time of the year, deliveries take about one week.

Cincinnati — Scarcity of cement; plenty of all other building materials.

New Orleans—Stocks of pine lumber are low but the demand is inactive. Plenty of other building materials available, with the possible exception of 4 in. sewer pipe.

Atlanta—Plenty of brick and lumber. Between fifty and sixty cars of cement, sixty to seventy cars of asphalt, about seventy cars of lime and from four to five cars of structural steel on sidings.

Philadelphia—Scarcity of asphalt and hollow tile. Well stocked with lumber with the exception of West Coast fir. No dealers' stocks of cement held in reserve as prompt mill deliveries render this practice unnecessary.

New York—Heavy reserves of burned common brick being piled up in Hudson River district. Brick shipments are prompt, and distribution is greater at the present time than during the peak of the building season. Plenty of other construction materials with the exception of sewer pipe. Small stocks in city in sizes above 6 in., mill deliveries slower than month ago.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of Oct. 4; the next, on Nov. 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.30	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	3.50	+3.95	3.20	3.45	3.85	3.65	4.10	3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	—53%	43%	47%	53–5%	36%	33.2@42.2%	35%	47.42
Cast-iron pipe, 6 in. and over, ton	63.60	—55.00	63.00	60.20	60.50	69.00	62.00	62.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	2.60	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	+2.00	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.00	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	+62.00	39.00	52.25	58.50	—44.75@45.75	+48.00	41.00	+29.50	70.00
Lime, finishing, hydrated, ton	18.20	+25.00	20.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	+1.60	1.75	1.50	1.50	2.70	2.10	2.80	—9.50
Common brick, delivered, 1,000	23.65	11.00	—11.60	11.00	17@19	12.00	15.00	15.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.115
Hollow partition tile 4x12x12, per block	.1179	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	+.98	+1.00	+1.09	1.14	+1.02	+1.12	+1.04	.86	+1.40
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	.50@.55	.35@.50	.50	.56¼@.62½	.30@.35

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93¾c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir, common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.88). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.42; 6-in., $119.

Changes Since Last Week

The present irregularity in demand is reflected in the firmness in prices of certain materials and a tendency toward weakness in certain others. Linseed oil, for instance, which is considered a barometer of the paint trade, has taken an upward turn due to higher flaxseed and increased demand. Raw oil advanced 2c. in San Francisco; 3c. in New York, Minneapolis and Denver; 4c. in Atlanta and 5c. per gal. in Dallas.

Lumber is also firmer. Pine advanced $1 in New York and fir 50c. in Seattle and $3.75 per M. ft. in Denver, during the week. A slight decline, however, is reported in Minneapolis on Douglas fir timbers.

Reinforcing bars advanced 15c. per 100 lb. and sand, 11c. per cu.yd. in Dallas. Hydrated finishing lime rose $2.50 per ton and common lump, 10c. per bbl. in Atlanta. Local stocks of steel bars are exhausted in Dallas.

Steel pipe discounts advanced 8 points and c.-i. pipe dropped $5 per ton in Atlanta. Brick dropped $1.50 per M. in Dallas and common lump lime, 50c. per ton in Montreal. Bars remain firm at $2.40 with plates and shapes at $2.50 per 100 lb., f.o.b. Pittsburgh.